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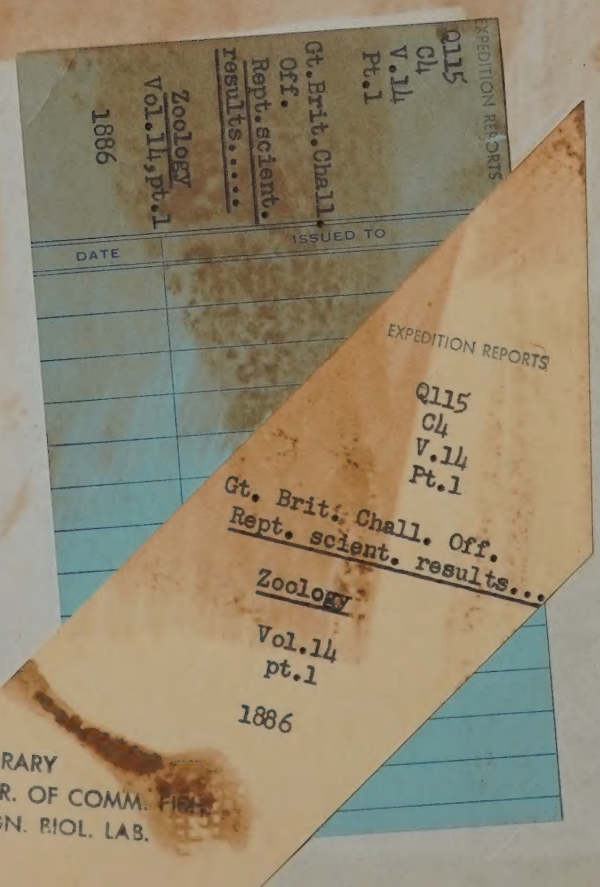

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REPORT

ON THE

SCIENTIFIC RESULTS

OF THE

VOYAGE OF H.M.S. CHALLENGER

DURING THE YEARS 1873-76

UNDER THE COMMAND OF

CAPTAIN GEORGE S. NARES, R.N., F.R.S.

AND THE LATE

CAPTAIN FRANK TOURLE THOMSON, R.N.

PREPARED UNDER THE SUPERINTENDENCE OF

THE LATE

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REGIUS PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF EDINBURGH
DIRECTOR OF THE CIVILIAN SCIENTIFIC STAFF ON BOARD

AND NOW OF

JOHN MURRAY

ONE OF THE NATURALISTS OF THE EXPEDITION

U.S. Fish Commission
no. 2895.

ZOOLOGY—VOL. XIV.

PART XXXVIII.—REPORT ON THE TUNICATA.

BY WILLIAM A. HERDMAN, D.Sc., F.L.S., F.R.S.E., &c.

Published by Order of Her Majesty's Government

2895

PRINTED FOR HER MAJESTY'S STATIONERY OFFICE.

AND SOLD BY

LONDON:—LONGMANS & CO.; JOHN MURRAY; MACMILLAN & CO.; SIMPKIN, MARSHALL & CO.
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EDITORIAL NOTE.

This Memoir on the Ascidiæ Compositæ forms the Second Part of Professor W. A. Herdman's Report on the Tunicata collected by the Expedition. The First Part of the Report was published in 1882, as part of Volume VI., and Part XVII. of the Zoological Series of Reports.

Professor Herdman is at present engaged in the preparation of the Third and concluding part of his Report, and it is expected to be ready for publication early in 1887.

John Murray.

Challenger Office, 32 Queen Street,
Edinburgh, 8*th May* 1886.

CORRIGENDA ET ADDENDA.

Page 24, under "*Synapta inhærens*, O. F. Müller, 1788," insert as synonyms "*Holothuria* (*Minyas?*) *flava*, Rathke, 1843, and *Synapta flava*, Lampert, 1885."

Page 26, under "*Synapta lumbricoides*, Eschscholtz, 1829," insert "*Synapta lumbricus*, Jæger, 1833."

Page 34, under "*Chirodota australiana*, Stimpson, 1856," insert "according to Semper, 1868, possibly a new genus, *Tæniogyrus*."

Page 34, under "*Chirodota violacea*, Peters, Müller, 1849," insert "*Hab.*, Amirante Islands (Bell, 1884)."

Page 34, under "*Chirodota lævis*, Fabricius, 1780," insert "*Chirodota pellucida*, Sars, 1861."

Page 101, under "*Cucumaria lactea*, Forbes, 1841," insert "*Hab.*, West Coast of France (Barrois, 1882)."

Page 112, under "*Cucumaria longipeda*, Semper, 1868," insert "*Hab.*, Japan (v. Marenzeller, 1881).

Page 209, under "*Holothuria gräffei*, Semper, 1868," insert "(?) *Stichopus troschelii*, J. Müller, 1854, and *Holothuria troschelii*, Müller, Lampert, 1885."

Page 240, under "*Ananus holothuroides*, Sluiter, 1880," insert "*Aproctus holothuroides*, Verloren, 1881."

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the TUNICATA collected during the Voyage of H.M.S. Challenger during the Years 1873–76. By WILLIAM A. HERDMAN, D.Sc., F.L.S., F.R.S.E., Professor of Natural History in University College, Liverpool.

PART II.—ASCIDIÆ COMPOSITÆ.

PREFACE.

THE first part of this Report, treating of the ASCIDIÆ SIMPLICES of the collection, was published in the end of 1882, and at that time it seemed probable that the remainder of the Tunicata could be described in a second and considerably smaller part which would be ready for publication some time in 1884. The Compound Ascidians, however, proved on careful examination to be a much larger and more varied group than had been anticipated. On account of the difficulty in finding good diagnostic characters, and of the similarity which different species sometimes show in their external appearance, it has been necessary to submit nearly all the specimens in the collection to a detailed histological examination, and portions of most of them have had to be sectionised—a slow and laborious proceeding—before the relations of their different parts could be satisfactorily determined. Then, in the case of a few species, some interesting peculiarities in regard to reproduction by gemmation, having an important bearing upon the mode of formation of the colony, required a careful and lengthened examination. For these

reasons the present part of the Report, though including only the Compound Ascidians, has taken longer to prepare and has reached a larger size than was expected. A description of the pelagic forms (the Pyrosomidæ, the Appendiculariidæ, and the Thaliacea), forming the third and concluding part of the Report, will probably appear during the next year.

The large collection of Ascidiæ Compositæ, which was for the most part found to be in good condition for histological examination, represents one hundred and two species and well-marked varieties, arranged in twenty-five genera. Eighty-eight of the species and ten of the genera are new to science. As no preliminary report upon the Compound Ascidians was published, these new genera and species are described here for the first time. I have found it necessary to form two new families, the Cœlocormidæ and the Polystyelidæ.

The Compound Ascidians collected during the cruises of H.M.SS. "Lightning" and "Porcupine" in the summers of 1868–70 were sent to me by Mr. Murray for examination. They have been incorporated in the Challenger collection, and the descriptions of them will be found in the Systematic Part of this Report.[1]

Since the publication of the first part of the Report, several specimens of Simple Ascidians belonging to the Challenger collection, which had previously been overlooked, have been sent to me for examination. I have placed the description of these forms as an Appendix at the conclusion of this part of the Report.

[1] The Simple Ascidians of the "Porcupine" and "Lightning" expeditions were described in a paper read in January 1884, before the Royal Society of Edinburgh, and published in its Transactions (*Trans. Roy. Soc. Edin.*, vol. xxxii. part ii. p. 219).

CONTENTS.

PAGE

INTRODUCTION, ... 5
History, ... 5
Bibliography, ... 8
Anatomy, ... 12
Classification, ... 12
The Colony, ... 12
The Test, ... 13
The Ascidiozooid, ... 15
The Mantle, ... 17
The Branchial Sac, ... 18
The Endostyle, ... 19
The Dorsal Lamina, ... 19
The Tentacles, ... 20
The Nervous System, &c., ... 20
The Alimentary Canal, ... 21
The Blood, &c., ... 22
The Reproductive Organs, ... 23
Gemmation, ... 24

DESCRIPTION OF THE SPECIES, &c., ... 27
Ascidiæ Compositæ, ... 28
Botryllidæ, ... 33
Botrylloides, ... 38
Sarcobotrylloides, ... 56
Polycyclus, ... 61

Distomidæ, ... 69
Colella, ... 72
Anatomy and Histology of *Colella pedunculata*, ... 77
Anatomy and Histology of *Colella thomsoni*, ... 95
Distaplia, ... 126
Genus doubtful, ... 132
Cystodytes, ... 135
Symplegma, ... 144

Polyclinidæ, ... 148
Pharyngodictyon, ... 152
Tylobranchion, ... 157
Atopogaster, ... 163
Morchellioides, ... 176

PAGE

DESCRIPTION OF THE SPECIES, &c.—*continued.*

Morchellium, ... 180
Sidnyum, ... 183
Polyclinum, ... 186
Aplidium, ... 199
Amaroucium, ... 214
Psammaplidium, ... 237
Genus doubtful, ... 251

Didemnidæ, ... 253
Didemnum, ... 260
Leptoclinum, ... 266

Diplosomidæ, ... 307
Diplosomoides, ... 309
Diplosoma, ... 313

Cœlocormidæ, ... 317
Cœlocormus, ... 318

Polystyelidæ, ... 322
Goodsiria, ... 327
Synstyela, ... 341
Chorizocormus, ... 345

GEOGRAPHICAL DISTRIBUTION, ... 351

BATHYMETRICAL DISTRIBUTION, ... 371

SUMMARY AND GENERAL REMARKS, ... 381
Phylogeny, ... 387

APPENDICES, ... 401
Appendix A. Supplementary Report upon the Ascidiæ Simplices, ... 401
Appendix B. Description of a new species of *Psammaplidium*, ... 419

INDEX, ... 421

EXPLANATION OF THE PLATES, ... 431

PLATES.

INTRODUCTION.

In the Introduction to Part I. of this Report, the accounts of the history, bibliography, and anatomy refer not to the Ascidiæ Simplices alone, but to the Tunicata as a whole; still, as the Simple Ascidians were undoubtedly discussed there more fully than the other groups, it seems desirable that the more important points in the history and the structure of the Ascidiæ Compositæ should be given here as an introduction to the description of so many new species of that section of the Tunicata.

HISTORY.

Although Compound Ascidians belonging to the family Botryllidæ were figured as far back as 1555 by Rondeletius, it was not until two hundred years later, when Schlosser and Ellis in 1756 brought before the Royal Society their account of a species of *Botryllus*, that anything was known of the structure of these colonies, and even then their relationship to the Simple Ascidians—some of the main points in the anatomy of which were known nearly two thousand years before—was not suspected. This relationship was made out by the conjoined efforts of several eminent naturalists who investigated the Tunicata during the concluding years of the eighteenth and the opening years of the nineteenth centuries.

Gaertner as early as 1774 evidently saw the relationship of the genus *Distomus*, which he had founded, with the other Tunicata, and Renier in 1793 published similar views in regard to the genus *Botryllus;* but it was left for Cuvier and Savigny, working during the first fifteen years of the present century, the former at the Simple Ascidians and the latter at the Compound, to demonstrate beyond all possibility of future doubt the close affinity between these two groups of the Tunicata. Up to the date of publication of Savigny's immortal "Mémoires" (1816), the Compound Ascidians then known had been confused by the majority of naturalists with the Alcyonaria or with the Sponges. This patient and accurate observer succeeded in determining, from material preserved in spirit, the complete anatomy of a large number of forms, and he founded ten genera, most of which are still recognised as being among the more important types of the Ascidiæ Compositæ. Lamarck about the same time, on the strength of the anatomical

discoveries made by Savigny and Cuvier, instituted the class Tunicata, which he placed between the Radiata and the Vermes in his system of classification.

In 1826 H. Milne-Edwards, while investigating along with Audouin the zoology of the Chausey Archipelago, off the coast of Normandy, made a number of observations upon Compound Ascidians in a living condition, and laid the foundations for his great work upon the group which was published some sixteen years later. He also at the same time was fortunate enough to discover the tailed larva,[1] and he traced its development into the adult Ascidian. Lister's observations, published in 1834, were made partly upon a species of the remarkable genus *Diplosoma*.[2] They referred mainly to the circulation of the blood. About this time Forbes and Goodsir, W. Thompson, Delle Chiaje, and others were steadily adding to the knowledge of the Compound Ascidians, and in 1842 Milne-Edwards' important memoir, "Observations sur les Ascidies Composées des côtes de la Manche," appeared, with its fresh anatomical and embryological discoveries, and its natural system of classification into (1) Botrylliens, (2) Didemniens, and (3) Polycliniens. Milne-Edwards had a great advantage over Savigny and others of his predecessors in having worked upon living material: some of the Compound Ascidians are greatly altered by preservation in alcohol.

Additions to the list of known species were made during the next few years by Forbes, Alder, and several others, and the article Tunicata in Todd's Cyclopædia, published in 1848, gives a good account of the knowledge of the Compound Ascidians at that time. A still more complete account was published some years later (1862) in Bronn's Thierreich. Dr. J. Denis Macdonald's observations upon some of the most remarkable forms of the Ascidiæ Compositæ were made about this time, viz., on *Chondrostachys* in 1858 and on *Diplosoma* in 1859. These excellent researches will be referred to later on in this work.

In 1862 Gegenbaur gave in Müller's Archiv an important account of the anatomy and development of *Didemnum gelatinosum*, and, a few years later, Kowalevsky's great memoir on the development of a Simple Ascidian made its appearance and threw a flood of light upon the interesting and peculiar tailed larva which had been described but not thoroughly investigated nor understood by Milne-Edwards and others. The relationship with the Vertebrata, which Kowalevsky established for the Simple Ascidians, held good of course for all groups of the Tunicata, and the similarity of the main points in structure and development between the larva of the Compound and of the Simple Ascidians has since been demonstrated by many observers.

The important observations of Krohn and Metschnikoff upon the process of gemmation in the Botryllidæ were published a few years later, and Kowalevsky's contributions to

[1] This, however, had been figured long before by Savigny both for Simple and Compound Ascidians (see Mémoires, pl. xi. fig 2-3, *Clavelina borealis;* and pl. xxi. fig. 1, *t*, *Botryllus polycyclus*).

[2] Usually referred to as a *Leptoclinum*.

the elucidation of the same process in other Compound Ascidians, and an important memoir in Russian on their embryology by Ganin, appeared about the same time.

Giard's large work on the Ascidiæ Compositæ, published in 1872, added greatly to the knowledge of the group. It contained careful descriptions of a number of new forms, and the definitions and arrangements of the families and genera, many of which were new, formed welcome and much needed aids to classification.

Since that date most of the works upon the Tunicata have dealt either with the Simple Ascidians or with the Thaliacea, but Della Valle in Italy, and von Drasche in Austria, have done good service in describing new forms amongst the Compound Ascidians, and the last named author has published in his Synascidiæ of the Gulf of Rovigno, a series of probably the most beautiful and life-like plates of Compound Ascidians which have yet appeared. Della Valle has also contributed considerably to our knowledge of the processes of gemmation in the various groups of the Ascidiæ Compositæ, but this question will have to be gone into more in detail further on in the present work.

Lastly, the Challenger Expedition has added a large number of new forms to the list of Compound Ascidians previously known, and some of these, besides the interest attaching to them on account of the localities or the great depths at which they were collected, have remarkable anatomical peculiarities, which render their discovery of some importance in the history of the group.

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ANATOMY.

The following account of the anatomy and histology[1] of the Compound Ascidians deals chiefly with the points in which the groups of these Tunicata differ from the Simple Ascidians and from one another in the arrangement and structure of their various organs, and therefore may be regarded as supplementary to the corresponding section of the Introduction to Part I. of this Report.

The minute anatomy of certain special forms (*e.g.*, *Colella pedunculata*, p. 77, and *Colella thomsoni*, p. 95) will be found in their proper places in the systematic part of the work; and the more important points of novelty and interest exhibited by the Challenger collection will be discussed in the General Summary at the conclusion of the Report.

Classification.

The scheme of classification given in Part I. (p. 25) is retained unchanged, except that the families Cœlocormidæ and Polystyelidæ have been added to Suborder II., the Ascidiæ Compositæ. The same system of nomenclature will still be made use of, and the body, when being described, is supposed to be in the position figured and explained on p. 27 of Part. I.

The Colony.

As all Compound Ascidians reproduce by gemmation, specimens are almost always found to be colonies consisting of a number of members. These members may be called

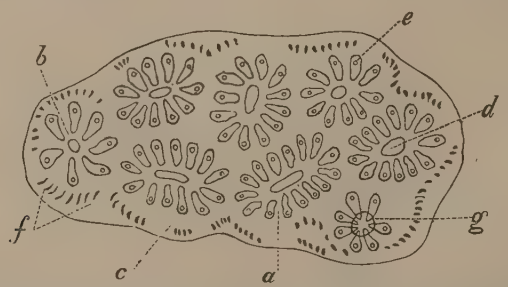


FIG. 1.—A Colony of a Compound Ascidian (*Botryllus*). The Ascidiozooids are arranged in eight systems.

a, a large system formed of fifteen Ascidiozooids; *b*, a small system formed of seven Ascidiozooids; *c*, the test or investing mass; *d*, a common cloacal aperture; *e*, an Ascidiozooid; *f*, the terminal knobs of the vessels; *g*, a system where the common cloacal aperture is fully expanded.

"Ascidiozooids,"[2] and the colony as a whole the "Ascidiarium" or "Cormus." If the Ascidiozooids are arranged in definite groups which can be distinguished from one

[1] For further details in regard to the structure of the Compound Ascidians I may refer the reader in particular to Giard's Recherches sur les Synascidies, and to Della Valle's Nuove Contribuzioni alla Storia Naturale delle Ascidie Composte; and also to the account of the structure of *Colella pedunculata* given further on in this Report (p. 74).

[2] This term was first used, I believe, by Huxley.

another, then the colony may be divided into "systems" or "cœnobii," each system consisting of a group of Ascidiozooids with the surrounding part of the common test or investing mass (see fig. 1, p. 12).

When there are no systems present the Ascidiozooids may either be scattered equally over the colony or be placed irregularly. In the Clavelinidæ, the only Simple Ascidians which reproduce by gemmation, the members of the colony are never arranged in systems. Usually, in the Compound Ascidians, the various Ascidiozooids of a system have their atrial apertures opening into a chamber, the common cloaca, which communicates with the exterior, and thus serves as the common excretory orifice of a number of Ascidiozooids (see fig. 1, where *g* shows the atrial ends of the Ascidiozooids projecting into the common cloaca; see also fig. 3 on p. 16).

The Test.

The ground mass or investing substance of the colony (*c* in fig. 1), in which the Ascidiozooids are imbedded, is homologous with the test or outer tunic of the Simple Ascidians, and ought to be called by the same name. Looked at merely from an anatomical and not from an embryological point of view, a Compound Ascidian colony may be regarded as a number of Simple Ascidians whose tests have completely fused with one another to form a common mass. In some cases this mass in place of being the same throughout is modified in the immediate neighbourhood of the Ascidiozooids, so that each member of the colony seems to have a test of its own, and these tests are then united by the colonial investing mass. Such an arrangement is, however, rarely met with.

In structure, the test of the Compound Ascidians agrees very closely with that of the Ascidiæ Simplices, consequently it is unnecessary to repeat the general characters given in the Introduction to the first part of this Report.[1] In most cases it remains in a comparatively unmodified condition, corresponding to that shown by the Clavelinidæ and the Ascidiidæ amongst Simple Ascidians; and it never assumes the fibrous condition found in most Cynthiidæ. As a rule it is soft, gelatinous, and semi-transparent, and exhibits no differentiation to the eye, except occasionally (*e.g.*, Botryllidæ) when "vessels" are particularly well developed (*f* in fig. 1; see also Pl. I. figs. 2 and 5). It may be rendered opaque by foreign bodies such as sand-grains adhering to or becoming imbedded in its surface (as in the case of many of the Polyclinidæ, *e.g.*, *Psammaplidium*, p. 237, and Pl. XXXI. fig. 9), or by the formation of pigment or of calcareous spicules in the interior. The matrix is homogeneous, or rarely exhibits a very delicate fibrillation under a high magnification; occasionally the outer layer is found to be slightly fibrous in structure. The cells in this matrix are mostly of small size, but may be of almost any

[1] Vol. vi. part xvii. p. 28, 1882.

shape;—round, fusiform, and stellate or branched shapes are the most common (Pl. XI. fig. 1, and many other figures). They comparatively rarely become modified into bladder cells or show much pigmentation. Bladder cells, if present, are usually in the outer layers of the test, and are of rather small size compared with those of Simple Ascidians.

A coloured test may be due to either of two causes—(1) the presence of numerous vessels containing coloured blood-corpuscles, (2) pigment cells in the test. The vessels are usually most abundant at the edges of the colony and close to the surface, while the pigment cells may be scattered evenly all through the test, or aggregated in one part, as in the case of *Colella murrayi* (see p. 117). In some cases (*e.g.*, many Didemnidæ, Pl. XLI. figs. 2, 5) calcareous spicules [1] are formed in the test, and these may become

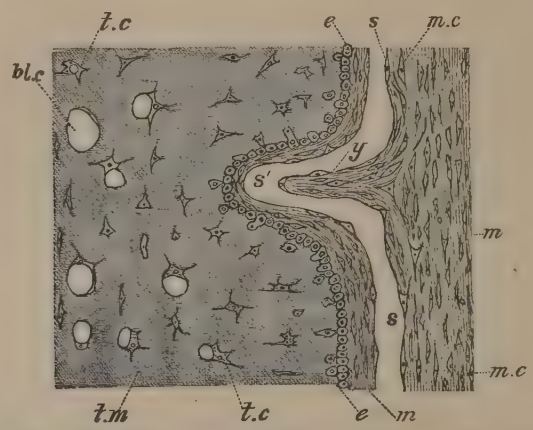


FIG. 2.—A diagrammatic section through part of the mantle and test, showing their relations and the mode of formation of a "vessel."

bl.c, a bladder cell in the test; *e*, the ectoderm; *m*, the mantle; *m.c*, a connective tissue cell in the mantle; *t.c*, test cells; *t.m*, the matrix of the test; *s*, a blood sinus in the mantle; *s'*, its continuation into the test to form a "vessel"; *y*, the septum of the young vessel formed by a continuation of the connective tissue of the mantle.

so numerous as to entirely change the character of the tissue, rendering it hard and brittle, and usually giving it an opaque white colour (see Pl. XXXV. fig. 1).

As in the case of the Ascidiæ Simplices, the test is sometimes penetrated by "vessels" in the form of prolongations from the mantle covered by a layer of ectoderm and containing a blood sinus (see fig. 2). These vessels may be very numerous, and have large terminal knobs or bulbs placed in the superficial layers of the test (as in some Botryllidæ), or they may be only very slightly developed (as in some Polyclinidæ). In some cases they contain powerful bands of muscle-fibres continuous with those of the mantle, and then seem to have changed their function (which was probably respiratory at first [2]) and to

[1] The relation of these spicules to the rest of the test is discussed further at p. 270.

[2] See Herdman, On a New Organ of Respiration in the Tunicata, *Proc. Lit. and Phil. Soc. Liverpool*, 1884–85, p. 39.

have become retractor muscles for the purpose of pulling the Ascidiozooids downwards into the test (as in the case of *Leptoclinum thomsoni*).

In some of the Compound Ascidians certain parts of the test may become very greatly enlarged so as to produce large massive colonies (such as *Atopogaster aurantiaca*, Pl. XXIII. fig. 7; and fig. 5, p. 27), or long peduncles upon which the rest of the colony and the Ascidiozooids are borne (*e.g.*, *Colella pedunculata*, Pl. V. fig. 1, and *Distaplia vallii*, Pl. XVIII. fig. 1, &c.; see also fig. 6, p. 27). Usually in such cases the enlarged part of the test becomes modified. Peduncles, for example, are almost invariably harder and tougher than the rest of the test. The superficial layer of test also frequently becomes slightly modified to form a firmer layer which may be stripped off as a membrane from the surface of the colony. In some cases the outer layer of the test may be prolonged into delicate processes for purposes of attachment (see Pl. XXXV. fig. 3), and such processes may become covered with adhering sand-grains so as to form a protecting sandy investment.

The Ascidiozooid.

The Ascidiozooids or members of the colony are usually placed vertically (at right angles to the upper surface) in the test. In the genus *Botryllus*, however, they are placed nearly horizontally, and in *Diplosoma* and some other forms they are inclined at all angles. The anterior end, indicated by the branchial aperture,[1] is always nearest to the outer surface of the colony, and the antero-posterior axis generally runs along the length of the body (see fig. 3, p. 16).

The Ascidiozooids vary greatly in shape in different groups of the Compound Ascidians. Savigny in 1816 pointed out and figured[2] most of these shapes, and in 1842 Milne-Edwards[3] arranged them in three groups, one characteristic of each of his great sections, Polycliniens, Didemniens, and Botrylliens. These divisions of the Compound Ascidians are no longer recognised, but still it is useful to employ Milne-Edwards' arrangement so far as it relates to the shape of the Ascidiozooids. In his group Polycliniens the body consists of three regions placed one behind the other—first, the branchial or "thorax" (see fig. 3); second, the intestinal or abdomen; and third, the reproductive or post-abdomen. The "thorax," to make use of Milne-Edwards' terms, contains the branchial siphon and branchial sac with all its accessory organs (endostyle, &c.), the nerve ganglion, and the terminal part of the rectum. The abdomen contains the alimentary canal from the œsophagus to the rectum, with any accessory digestive glands or cæca which may be present. The post-abdomen is composed of the reproductive organs—with the exception of the greater part of their ducts, which pass upwards into the abdomen and the thorax—and of the heart. From the posterior end of the post-abdomen occasionally one or

[1] See Part I. of this Report, p. 27. [2] Mémoires, &c. [3] Observations, &c.

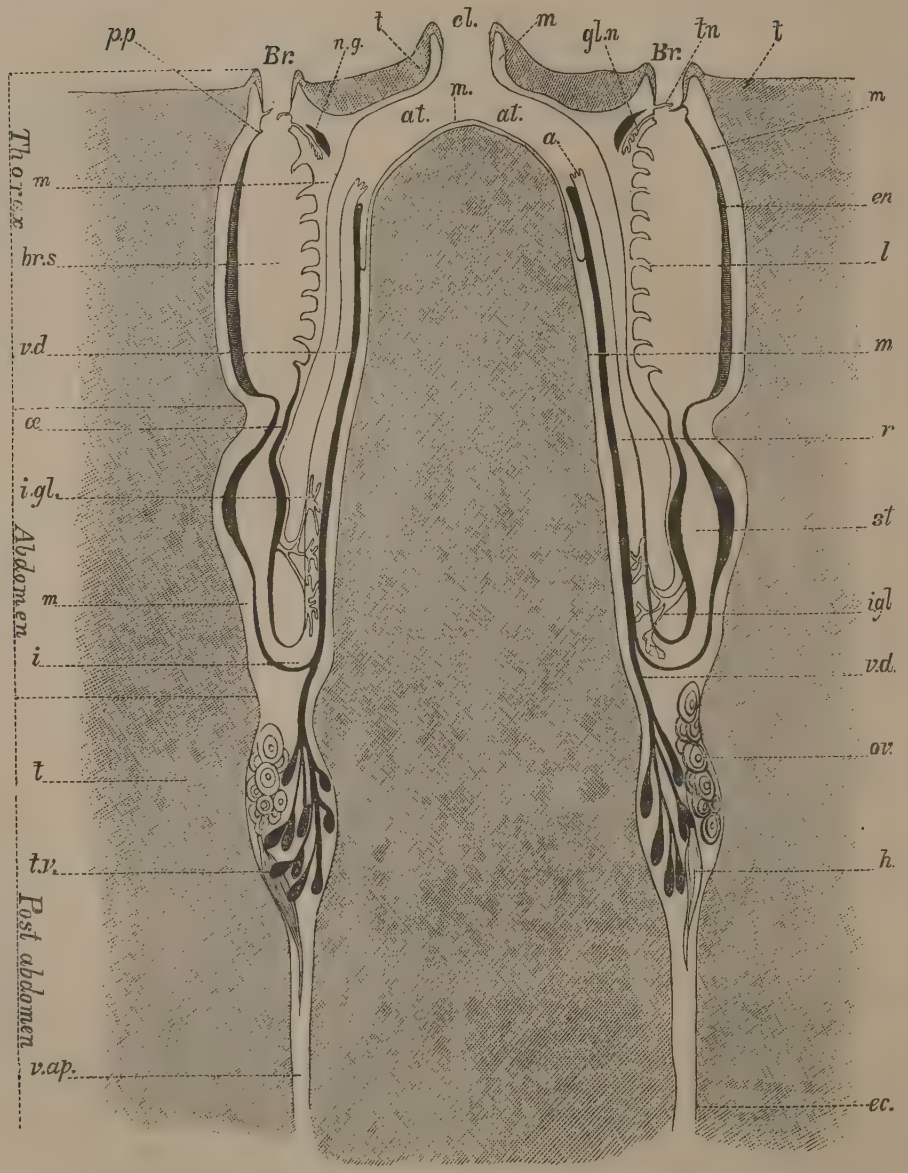


FIG. 3.—Diagram showing a Compound Ascidian Colony composed of two Ascidiozooids united to form a system.

a., anal aperture; *at.*, atrial cavity opening into the common cloacal cavity; *Br.*, branchial aperture; *br.s.*, the branchial sac; *cl.*, common cloacal aperture; *ec.*, the ectoderm bounding the vascular appendage; *en*, endostyle; *gl.n*, neural gland; *h.*, heart; *i*, intestine; *i.gl.*, hepatic gland on the intestine; *l*, languet; *m*, mantle; *n.g.*, nerve ganglion; *œ*, œsophagus; *ov.*, ovary; *p.p*, peripharyngeal band; *r*, rectum; *st*, stomach; *t*, the test or investing mass; *tn*, one of the tentacles; *t.v.*, a testicular vesicle; *v.ap.*, the vascular appendage; *v.d.*, vas deferens. The limits of the thorax, abdomen, and post-abdomen are shown by the dotted lines extending outwards to the left, one at the lower end of the endostyle and another below the intestinal loop.

more "vessels" are continued downwards into the test (see fig. 3, *v.ap.*). The Ascidiozooid is of this form in the family Polyclinidæ. In the group Didemniens there is no post-abdomen. The reproductive organs and the heart are placed in the abdomen alongside the intestine, so that the body consists of two divisions only (Pl. V. fig. 13). The Ascidiozooid is of this form in the following families :—Distomidæ, Didemnidæ, and Diplosomidæ. Finally, in Milne-Edwards' Botrylliens, the body cannot be divided into regions. The alimentary canal, the reproductive organs, and the heart are all placed alongside the branchial sac or project very slightly beyond it (Pl. II. fig. 7). The post-abdomen and abdomen seem to have been drawn upwards into the thorax. The families Botryllidæ and Polystyelidæ have Ascidiozooids of this form.

In some cases the division into the above described regions is very distinct, the body being constricted between them so as to form two (Didemniens) or three (Polycliniens) masses united by narrow pedicles (Pl. XXI. fig. 5); but in other cases, although the regions are anatomically present, they are not apparent without dissection, the body being equally or nearly equally thick all the way down (Pl. XXVI. fig. 4).

The Mantle.

The mantle has precisely the shape of the Ascidiozooid, of which it forms the covering inside the ectoderm. The latter separates it in all parts from the test, with which it therefore never comes into direct contact. The mantle is formed by connective tissue uniting and enclosing bundles of muscle-fibres, nerves, and blood-spaces. In its histology it resembles closely the mantle of the Ascidiæ Simplices. It varies considerably in its thickness and in the condition of its musculature in the different species of Compound Ascidians. In some cases, both longitudinal and transverse (circular) muscle bands are present, and the transverse bands are the strongest and the most regularly placed. Figure 10 on Plate X. shows this condition of the mantle. In others they are placed with very great regularity, and the longitudinal bands are almost absent. In other Compound Ascidians, however (*e.g.*, *Colella ramulosa*, Pl. XV. fig. 17), the longitudinal muscle bands are more marked and more regular than the transverse ones, and, in some cases, the latter are almost absent while the longitudinal bands are then very powerful. In some few cases (*Tylobranchion speciosum*, see Pl. XXII. fig. 4) the muscle bands over the branchial sac are strong, and branch like those of a typical *Ascidia;* usually they are more delicate than in any of the Ascidiidæ. The muscle fibres in the mantle are always unstriped. The sphincters surrounding the branchial and atrial siphons (where the latter opens independently) are usually well marked in Compound Ascidians.

In some forms (*e.g.*, *Colella pedunculata*, see p. 89) the median dorsal part of the mantle near the anterior end of the peribranchial cavity is prolonged to form a diverticulum which varies in size from a scarcely perceptible enlargement to a long spirally coiled

cæcum as large as, or even larger than, the body of the Ascidiozooid (see Pl. V. figs. 11, 12, and 13). This is the incubatory pouch, in which the embryos undergo their development. Its wall is usually thin, and its muscle-fibres are few and delicate.

The mantle apparently does not contract so much at death in Compound as in Simple Ascidians, consequently there is rarely any space between it and the test even in spirit specimens. In some cases, however, contraction does take place, which results in the body of the Ascidiozooid being drawn downwards into the test so that the ectoderm (which connects the mantle and the test) is torn, and the branchial siphon is retracted from the surface.

The mantle is sometimes considerably pigmented, just as in the case of some Simple Ascidians, and may in consequence become very opaque (*e.g.*, *Distaplia vallii*, Pl. XVIII. fig. 5); the pigmentation may be due to the presence of blood sinuses filled with coloured blood-corpuscles, or to pigmented connective-tissue cells. The mantle is bounded both externally and internally by an epithelial layer. The outer of these is the ectoderm, usually a very distinct membrane formed of large and distinctly nucleated cells, and the inner is the parietal layer of the lining membrane of the peribranchial cavity. This latter is formed of squamous epithelium, and the cells are not so clearly visible as those of the ectoderm.

The anterior end of the mantle, forming the branchial siphon, is usually divided into six lobes, which may be very distinct (see Pl. XXV. fig. 9), rarely there are eight (*e.g.*, *Morchellioides affinis*). In some cases there are no lobes, or the margin is irregular. When the Ascidiozooids are arranged in systems the mantle at the atrial aperture may be prolonged to form a projection, the atrial languet (see Pl. XXIX. fig. 15) which contributes to form the edge of the common cloacal aperture of the system.

The Branchial Sac.

This organ varies greatly both in size and structure throughout the Ascidiæ Compositæ (see fig. 4, p. 21, *br.s.*, and also the plates). In the Botryllidæ it is nearly as large as the body of the Ascidiozooid, in the Distomidæ, &c., it is usually about half the size of the body, while in the Polyclinidæ it may be less than one-fourth of the length of the body. Usually the antero-posterior extent of the sac is much the greater, but in some cases (*e.g.*, *Polyclinum minutum*) it is as broad as it is long. It is never thrown either into folds or into minute plications, the corrugated condition in which it is found in some spirit specimens being due, I believe, to contraction on death.

The essential structure of the branchial sac is the same as in the Simple Ascidians, and the three chief systems of vessels[1] are recognisable. The internal longitudinal bars are, however, rarely present. They are seen in the Botryllidæ and in *Symplegma*.

[1] See Part I. of this Report, Introduction, p. 32.

The transverse vessels and fine longitudinal vessels are found in all possible conditions, and the stigmata may vary from small circular openings (Pl. XXV. fig. 14) to very long narrow slits with parallel sides (Pl. VI. fig. 10), but they are never curved. The stigmatic ciliated cells may also vary greatly in form (see Pl. VI. figs. 12, 13; and Pl. XI. fig. 7, &c.). In some cases where the internal longitudinal bars are absent, rudiments of the connecting ducts in the form of papillæ projecting from the transverse vessels are present (*Tylobranchion speciosum*, see Pl. XXII. fig. 9), but generally they are entirely absent except along the dorsal lamina, where they form the series of languets. Horizontal membranes hanging from the transverse vessels are very frequently present, and may be wide or narrow (Pl. XXV. fig. 8 and Pl. XV. fig. 16). The number of rows of stigmata varies from three (*Didemnum savignii*) to about twenty (*Atopogaster aurantiaca*), and the number of stigmata in each row from four or five up to a large number. In the embryos of most of the Compound Ascidians, even of those species which have a large number of rows in the adult, there are four rows of stigmata on each side of the sac.

In *Pharyngodictyon mirabile* (p. 154, Pl. XXI. fig. 12) the branchial sac has the simple structure seen in the genera *Culeolus*, *Fungulus*, and *Bathyoncus* amongst Simple Ascidians.[1] It is composed of two sets of large vessels intersecting at right angles so as to form large quadrangular meshes. Probably the fine longitudinal vessels are undeveloped, and in that case no true stigmata are present.

The Endostyle.

This is generally a very conspicuous organ in the body of an Ascidiozooid, and is relatively larger than in Simple Ascidians. It is sometimes straight, and runs antero-posteriorly, but more usually its course is very undulating, turning first to the one side and then to the other so as to form a series of closely placed folds (Pl. XXII. fig. 6). It never extends beyond the posterior end of the dorsal edge of the branchial sac. It is formed of elongated columnar epithelium, richly ciliated in places.

The Dorsal Lamina.

This may be present in Compound Ascidians, or it may be represented by a series of languets which are, I believe, homologous with the connecting ducts of the branchial sac (see p. 161). When a dorsal lamina is present (*e.g.*, *Botrylloides tyreum*,[2] see Pl. II. fig. 8, *d.l.*) it is a plain membrane with neither transverse ribs nor marginal teeth; it may, however, be corrugated at its free edge, especially near the anterior end.

Languets when present are usually triangular flaps flattened antero-posteriorly

[1] Part I. of this Report, pp. 90, 127, and 165.

[2] Named *Botrylloides purpureum* on the plate, and in the description, p. 41.

(Pl. XI. fig. 10), but they may, on the other hand, be tapering tentacle-like processes (*e.g.*, *Atopogaster aurantiaca*, Pl. XXIII. figs. 11, 12) with no antero-posterior flattening. They are always richly ciliated along the edges.

The Tentacles.

The tentacles are simple in all Compound Ascidians, and are usually few in number and placed at regular intervals round the base of the branchial siphon. Eight and sixteen are usual numbers, but occasionally only four or even two (*Polycyclus cyaneus*, v. Drasche) are present. In other cases they are more numerous, and in *Tylobranchion speciosum* the number is large and the arrangement indefinite, as in a Simple Ascidian. Very often the tentacles are of two sizes, which are then placed alternately. Sometimes the tentacles are richly pigmented.

The Nervous System and other Neighbouring Organs.

The nerve ganglion is usually elliptical in form, and occupies the same position as in the Ascidiæ Simplices: it gives off nerves anteriorly and posteriorly. The mantle in the neighbourhood of the nerve ganglion is frequently pigmented, and in some Compound Ascidians small pigment-spots, which are probably lowly developed sense organs, are found along the edge of the branchial aperture just as in the case of most Simple Ascidians. A second small ganglionic enlargement is said to have been found on a nerve going to the atrial aperture in some species where the edge of the common cloacal aperture is well developed and sensitive.

In close relation to the nerve ganglion, and usually on its posterior side, is placed the neural gland, which is comparatively slightly developed in the Compound Ascidians, and gives off the neural duct running anteriorly and ventrally to open into the anterior end of the branchial sac by the aperture of the dorsal tubercle (see fig. 3, p. 16, *gl.n*). This opening is usually a simple circular or ovate slit (Pl. II. figs. 8, 9) placed in the dorsal line of the prebranchial zone behind the tentacles, and having slightly raised lips which form the inconspicuous "tubercle." The region of the neural duct nearest to the opening is generally enlarged to form an infundibulum with ciliated walls (see Pl. III. fig. 8, *inf.*).

The peripharyngeal bands surrounding the branchial sac at the level of the anterior ends of the endostyle and the dorsal lamina, and defining the posterior border of the prebranchial zone, in most cases bend posteriorly in the dorsal median line to bound a more or less triangular diverticulum from the prebranchial zone. This diverticulum corresponds to the peritubercular area in the Ascidiæ Simplices, but in the Ascidiæ Compositæ it rarely encloses the dorsal tubercle, which is placed considerably further forward (Pl. III. fig. 16).

The Alimentary Canal.

This tube, consisting of the œsophagus, the stomach, the intestine, and the rectum, varies greatly in its size, its arrangement, and its position in the body in the different groups of Compound Ascidians. In the Botryllidæ it lies almost entirely alongside the branchial sac, while in most other forms it extends for a longer or shorter distance behind it. The typical and probably the primitive arrangement is that shown in fig. 4, A., where the œsophagus (*œ.*) commences at the posterior end of the dorsal edge of the branchial sac (*br.s.*) and runs backwards to open into the anterior end of the ovate stomach (*st.*).

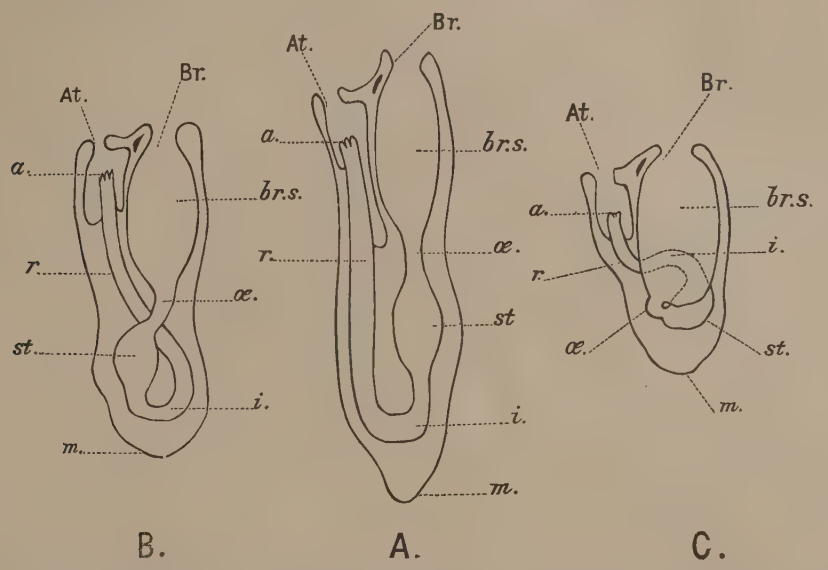


FIG. 4.—Three diagrams showing some of the more important variations of the alimentary canal found in Compound Ascidians. A. is probably the primitive condition, and corresponds to *Ciona* amongst Simple Ascidians. In C. an arrangement is shown, corresponding to *Ascidia*, which has been produced by pulling up the intestinal loop or by a downward extension of the branchial sac. B. shows a twisting of the loop, which causes the stomach to lie on the dorsal edge of the abdomen. B. may very readily be converted into C.

a., anus; *At.*, atrial aperture; *Br.*, branchial aperture; *br.s.*, branchial sac; *i.*, intestine; *m.*, mantle; *œ.*, œsophagus; *r.*, rectum; *st.*, stomach.

The intestine (*i.*) arises from the posterior extremity of the stomach and runs backwards for a short distance, and turns dorsally and then anteriorly to form a narrow loop. It may then be called the rectum (*r.*), which runs forwards alongside the stomach and œsophagus till it reaches the neighbourhood of the branchial sac, where it ends by opening (*a.*) into the peribranchial cavity in the neighbourhood of the atrial siphon (*At.*). From this primitive form two series of modifications have started. In the one the intestinal loop has been drawn forwards so as to lie upon the left side of the branchial sac with the intestine in front of the stomach. This produces the state of affairs found

in the Botryllidæ (fig. 4, C., and Pl. III. fig. 17), where the branchial sac is relatively much larger than in other forms, and the œsophagus runs ventrally to open into the large stomach, which is inclined ventrally and a little anteriorly. The intestine after leaving the stomach runs anteriorly and then dorsally and then turns anteriorly again to become the short rectum. The second series of modifications consists in the twisting of the intestinal loop so that the stomach comes to lie upon the dorsal in place of the ventral edge of the intestine (see fig. 4, B.). This condition is seen in various degrees of perfection in some of the Distomidæ and Didemnidæ.

The œsophagus is usually narrow, but may be of considerable length (Pl. IV. fig. 7). The stomach is thick-walled and large. Sometimes its surface is smooth, but in many cases it has conspicuous longitudinal folds which project as ridges into the interior (Pl. XXX. figs. 6, 7); occasionally these folds are represented by short detached cæca (Pl. XXV. fig. 6). The intestine may be a simple tube, or may be divided into several regions distinguished from one another by their calibre and the thickness of their walls (Pl. XLI. fig. 2). The rectum is always thin-walled, and is sometimes very wide. It may vary in calibre at different points, and sometimes it is folded. The anus may have a large margin, either plain or lobed. In some cases it opens near the posterior and in others near the anterior end of the peribranchial chamber.

Many of the Ascidiæ Compositæ have a system of tubules branching over the wall of the intestine, which clearly corresponds to the digestive gland of a similar nature found in many Simple Ascidians.[1] The duct from this system runs across from the intestine and opens into the stomach. A short cæcum may be present near the posterior end of the stomach at the point where the duct opens (see Pl. III. fig. 21). The exact function of this system is still unknown.

Heart, Blood, &c.

The heart varies in position in the different families. In the Botryllidæ it is placed close to the stomach alongside the branchial sac. In the Distomidæ, &c., it is placed alongside the intestinal loop on the right side, and runs antero-posteriorly. In the Polyclinidæ the heart is placed at the posterior end of the post-abdomen behind the reproductive organs (see fig. 3, p. 16, *h.*), and is bent so as to form a loop concave anteriorly. The structure of the heart and of the blood is the same as in the case of the Simple Ascidians. A large number of the blood-corpuscles may in some cases be pigmented. These are usually opaque white or red or purple.

The so-called vascular appendages, which form prolongations from the bodies of the

[1] See Part I. of this Report, Introduction, p. 49. Roule (Recherches sur les Ascidies Simples des Côtes de Provence) states that this is a system of blood sinuses! I am convinced that in some of the species in which I have investigated it the main duct opens into the alimentary canal.

Ascidiozooids in some species (see fig. 3, p. 16, *v.ap.;* and Pl. V. fig. 13), are really diverticula of the mantle, and are composed of a layer of ectoderm and, inside that, of connective tissue containing two blood sinuses running side by side, and therefore correspond to the blood-vessels of the test in Simple and some Compound Ascidians. The vascular appendages may in some cases (*e.g.*, *Colella concreta*, and many of the Didemnidæ) contain muscle fibres continuous with the musculature of the mantle. Blood sinuses or lacunæ are present in all parts of the body, and form the greater part of the circulatory system.

A mass of a glandular nature, and having usually a yellowish-green colour, which coats the first part of the intestine, is in all probability of a renal nature, and corresponds to the renal vesicles found in many Simple Ascidians (*e.g.*, *Ascidia mammillata*, *Ascidia meridionalis*, &c.).

The Reproductive Organs.

The Ascidiozooids are probably in all cases hermaphrodite, but in many forms the ova and the spermatozoa are produced at different times, and are therefore not found mature together. The usual arrangement[1] is for the ova to form first, and then after they have been laid or have passed into the incubatory pouch the spermatic vesicles commence to develop. This protogynous arrangement of course prevents self-fertilisation.

The genital glands may be placed on the sides of the branchial sac, as in the Botryllidæ, where there is usually an ovary and a group of spermatic vesicles upon each side of the body (see Pl. II. figs. 10, 11). A more usual arrangement is for the genital glands to be placed in the intestinal loop, either alongside the intestine as in the Distomidæ, Didemnidæ, &c. (Pl. V. fig. 13), or projecting beyond the intestine posteriorly to form a shorter or longer post-abdomen (fig. 3, p. 16) as in the Polyclinidæ (Pl. XXI. fig. 5).

The ovary is simply a group of more or less completely developed ova and germinal cells (Pl. VII. fig. 7), and there is probably no true oviduct present.[2] The spermatozoa may be formed in a single large testis (as in *Didemnum savignii*, Pl. XXXIV. fig. 2) or in a large number of small testes or spermatic vesicles (fig. 3, p. 16) which vary in shape and arrangement in the different groups (see descriptions of the genera and species in the Systematic Part of the Report). A distinct vas deferens is always present, and it is usually a very conspicuous tube which runs alongside the rectum in its entire length (Pl. XXV. fig. 6). In some cases (*Leptoclinum speciosum*) the vas deferens commences by coiling spirally around the large testis. In other forms the vas deferens is convoluted in its entire course. It opens into the peribranchial cavity close to the anus.

[1] Della Valle states that most are protandrous. That is not my experience, as will be seen in the description of the species further on in the Report, see also Summary at end.

[2] The evidence in regard to the oviduct is very conflicting. Some observers describe it as being present in many forms, others say that it is never found in any Compound Ascidian. I have been unable to find it in any I have examined.

Usually the embryos undergo their entire development in the body of the parent, either in the peribranchial cavity or in a special incubatory pouch, and do not pass into the outer world until they have become completely developed tailed larvæ.

Gemmation.

The budding of Compound Ascidians is a very important process—(1) because it is a very common method of reproduction with most species, and (2) because it has a most important bearing upon the characteristics of the colony.

Reproduction by gemmation takes place in a number of different ways amongst the Ascidiæ Compositæ, in fact nearly every species in which the process has been carefully examined has been found to have a method more or less peculiar to itself. Most of these methods, however, fall into one or other of a few main types of budding, and in all cases the process may be considered as consisting of the giving off from the parent Ascidiozooid of a number of cells containing representatives of the three primary layers of its body, ectoderm, mesoderm, and endoderm.

Giard in 1872[1] recognised four distinct methods of budding which he called stolonial, pallial, ovarian, and pyloric, and as these names are useful in indicating the positions of the buds, they may be retained with advantage.

Stolonial is the process seen typically in the Clavelinidæ amongst Simple Ascidians, but found also sometimes in the Botryllidæ (see p. 59). Here the bud is formed from the enlarged knobs upon the so-called "vessels" or stolons, which are really prolongations of the ectoderm and mantle of the posterior part of the body, and contain prolongations of the vascular sinuses of the mantle (see fig. 2, p. 14).

Pallial budding is seen also in the Botryllidæ, as was shown long ago by Krohn and by Metschnikoff, and it is by this process that the systems in the colony are mainly formed. The bud is produced as a lateral outgrowth from the body of the parent Ascidiozooid.

Ovarian budding is found in the Polyclinidæ, where the reproductive organs extend behind the alimentary canal to form what is called the post-abdomen. This region of the body gives rise to buds either by breaking up into a number of pieces or by giving off processes. This method of budding is really the same as the stolonial. In the first place there are several cases known which seem to be intermediate between the two, and where it is impossible to say definitely which process is followed; and secondly, the post-abdomen is simply a vascular appendage or stolon which has become in great part filled up by the large reproductive organs of the Polyclinidæ, and the process given off from the post-abdomen has exactly the same structure as the knob upon one of the vessels of the Botryllidæ.

[1] Recherches sur les Synascidies, *Archives d. Zool. expér.*, vol. i. p. 570.

The pyloric method of budding is seen in the Didemnidæ, and the buds are formed as enlargements upon the ends of long tubular projections from the body-wall in the region where the thorax joins the abdomen. Such projections have precisely the same structure as the vessels in the Botryllidæ, but of course differ from them in position.

In the Diplosomidæ, and some Didemnidæ, an interesting modification of pyloric budding is found, in which the new Ascidiozooid is formed of two buds[1] from the parent body, which give rise to the thorax and the abdomen respectively, and only unite late on in their development. Della Valle[2] has added considerably to our knowledge of this method of gemmation, and has shown that the thoracic bud is derived from the wall of the peribranchial cavity of the parent, while the abdominal bud is formed as a diverticulum from the œsophagus.

This author states that in the Botryllidæ buds are only formed from the parietal layer of the peribranchial membrane, and are never formed in connection with the vascular prolongations of the ectoderm as had been declared by previous investigators. I have been able to satisfy myself, however, that Della Valle is mistaken on this point, and that, in the case of one species at least (*Sarcobotrylloides wyvillii*, see p. 59), buds are formed in the dilatations on the vessels of the test (see Pl. IV. fig. 13), and therefore probably the observations of Milne-Edwards, Giard, and others, in which the "marginal tubes" were described as being connected with reproduction by gemmation, were perfectly correct.

Wherever it is formed, I believe that the bud always contains (1) a cellular coating derived from the ectoderm of the parent; (2) some mesoderm cells, usually in the form of young ova; (3) some endoderm cells, either in the form of a diverticulum from some part of the alimentary canal of the parent, or as a group of undifferentiated blood-corpuscles, which in the young animal are formed from the hypoblast. The young bud soon takes the form of two concentric cellular layers, the primitive ectoderm and endoderm, with a few mesoderm cells between. The endodermal sac then becomes constricted at two points so as to divide its cavity into three sacs, the middle one becoming the alimentary canal and the two others joining to form the peribranchial cavity of the adult. The primitive alimentary canal soon divides into a larger anterior part, the future pharynx or branchial sac and a smaller posterior region, the future stomach and intestine. The stigmata form as slits in the double membrane separating the lumen of the branchial sac from the peribranchial cavity, the intestine elongates, and other organs begin to make their appearance. The further course of the development of the bud differs somewhat in the different groups of Compound Ascidians.[3]

[1] According to Jourdain's recent researches, however (*Comptes rendus*, t. c. p. 1512, 1885), the two buds arise as a single outgrowth from the œsophageal region of the parent Ascidiozooid, and afterwards separate.

[2] Nuovi Contribuzioni alla Storia Naturale delle Ascidie Composte, *Reale Accad. dei Lincei*, Roma, 1881.

[3] For further details of the process of gemmation in the genus *Colella*, see pp. 90 and 101.

DESCRIPTION OF THE GENERA AND SPECIES, &c.

In the following specific descriptions I have followed the same system as that which was adopted in the case of the Simple Ascidians described in Part I. of this Report. The only point which requires special explanation is the method of measurement which I have employed, and which is shown in the accompanying diagrams.

In the case of a sessile massive colony, such as the one in fig. 5, the "length," AB, is the distance from the point of attachment, B, to the highest point on the top of

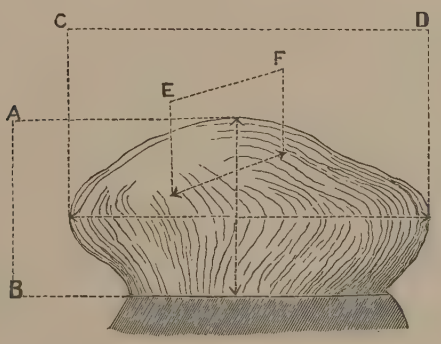


Fig. 5.

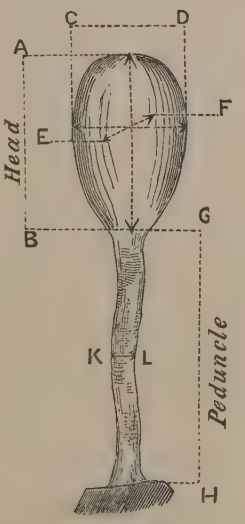


Fig. 6.

FIG. 5.—Diagram of a sessile massive colony to show the length (AB), the breadth (CD), and the thickness (EF).
FIG. 6.—Diagram of a stalked colony to show the "head," the "peduncle," and the various measurements.

the colony, A; the "breadth," CD, is the greatest horizontal diameter, and the thickness, EF, is the greatest (or the average) diameter at right angles to CD, not necessarily in the same plane. In the case of a pedunculated colony (see fig. 6) the dimensions of the "head" and of the "peduncle" are given separately. AB is the length, CD the breadth, and EF the thickness of the head; while GH is the length and KL the thickness of the peduncle. The length and the breadth are, except when the contrary is stated, the extreme length and breadth, but the thickness is usually the average or most

general thickness. In the measurements of an Ascidiozooid, the length is the entire antero-posterior extent from the branchial aperture to the posterior end of the body, exclusive of the vascular appendage when present, the breadth is the greatest dorso-ventral extent, and the thickness is the distance from the right to the left hand side of the body.

ASCIDIÆ COMPOSITÆ.

The Ascidiæ Compositæ, from which I exclude the family Clavelinidæ, may be defined as fixed Ascidians which reproduce by gemmation so as to form colonies in which the Ascidiozooids are imbedded in a common test or investing mass.

This suborder, then, is readily distinguished from the Thaliacea and the Larvacea, and from the Ascidiæ Salpiformes, all of which are free swimming; but although a typical Compound Ascidian may readily be separated by well-marked characteristics from a typical Simple Ascidian, it is very difficult if not impossible to frame a definition which will hold good for all the Ascidiæ Compositæ, while excluding all the Ascidiæ Simplices.

There are series of forms which bridge over, I believe, every gap which has been pointed out as existing between the two groups, and at the present time I find myself unable to fix upon a single satisfactory character by which to distinguish the Compound from the Simple Ascidians. This is not to be wondered at, however, when we consider the great amount of individual variation, and the difficulty of defining the limits of allied species and genera in the Tunicata; and it even seems perfectly natural when we investigate the course of the phylogeny of the group, and find that in all probability the Compound Ascidians are polyphyletic, having been derived from several distinct groups of ancestral Simple Ascidians (see further on in this Report under Summary). They are thus a semi-artificial assemblage, consisting of those fixed [1] Ascidians which have retained or acquired the power of reproducing by gemmation, so as to form colonies, and in which the Ascidiozooids have become so intimately united that their tests form a common colonial mass.

Savigny in 1815 [2] first rescued the Compound Ascidians from the Alcyonaria with which they had previously been associated, and demonstrated their affinity with the other Tunicata. In the Tableau Systématique, Savigny gives no formal statement of the characters by which he distinguished the Simple from the Compound Ascidians, but it is evident from some passages in his 3e Mémoire that he relied chiefly, if not entirely, for their separation upon the arrangement of the Ascidiozooids of the Compound forms around a central cloaca, a character which he declared was visible even in the young embryo. In this latter point he was mistaken, and it seems rather singular that he should have laid such stress upon the union of the atrial apertures when we find that he

[1] *Cœlocormus huxleyi* seems to be unattached, but is probably not free-swimming.

[2] Observations sur les Alcyons gélatineux à six tentacles simples.

describes and figures their separate and independent existence in *Diazona* and *Distoma*, two of the genera of his Téthyes Composées. *Clavelina* in his system is placed—rightly, I consider—next to the "Phallusiæ Cionæ" (the modern genus *Ciona*) among the Ascidiæ Simplices.

Savigny classified the ten genera which he recognised amongst Compound Ascidians by means of characters taken from the branchial and atrial apertures. But although such characters are most useful and constant marks of affinity in the Simple Ascidians, they fail signally as applied by Savigny to the Compound forms, and result in the separation of his closely allied genera *Didemnum* and *Eucœlium*, while *Diazona*, *Distoma*, and *Sigillina* are thrown together in one group, although really belonging to distinct families, and *Eucœlium* is placed with *Botryllus*, a genus with which it has certainly no close relationship.

Lamarck's classification of the Tunicata, published about the same time, was based upon the arrangement of the Ascidiozooids in the colony, but the result was no better than that obtained by Savigny's method, since *Polyclinum* was united with *Polycyclus* and *Botryllus*, *Eucœlium* was united with *Aplidium*, and *Distomus* was grouped along with *Sigillina*, while *Aplidium*, *Polyclinum*, and *Sigillina* were widely separated.

Cuvier, writing shortly afterwards, refused to accept the majority of Savigny's and Lamarck's genera, on the ground that they were not sufficiently distinct from one another. Subsequent investigators have not supported him in this view. Savigny's genera are still nearly all retained, and some have even been broken up into several groups now regarded as distinct genera.

The next classification of importance is that of Milne-Edwards, published in 1841, and one of the most notable features of his arrangement is that it involves the separation of the Clavelinidæ (at that time the two genera *Perophora* and *Clavelina*) as a distinct group, the Ascidiæ Sociales, occupying an independent position between the Simple and the Compound Ascidians. He defined this new group as comprising Ascidians which reproduce by buds as well as by eggs, and which live united by common radiciform prolongations, but which otherwise are free of all adhesion to one another. He distinguished the Simple Ascidians as forms which never reproduce by gemmation and are never found in groups united by a common tegumentary tissue; while he separated the Compound from the Social Ascidians on account of their possessing a test common to all the members of the colony. If we unite the Simple and Social Ascidians, which, as I have shown in the first part of this Report,[1] there is reason for doing, we shall have, according to Milne-Edwards, the Simple and Compound Ascidians distinguished merely by the members of the colony in the latter being united by a common test, while in the former each individual has its own distinct tunic. This character, although much better than the one made use of by Savigny, is, as we shall see later on, by no means an infallible guide.

[1] See vol. vi. part xvii., where the Clavelinidæ are treated as a family of the Ascidiæ Simplices.

Milne-Edwards classified the genera of the Compound Ascidians in three "tribes," the "Polycliniens," the "Didemniens," and the "Botrylliens," an arrangement which with our present knowledge of the group still seems fairly natural in some respects. These three divisions are distinguished by such anatomical characters as the relations of the other viscera to the branchial sac. In the "Polycliniens" the body has three regions—the "thorax," containing mainly the branchial sac; the "abdomen," formed chiefly of the stomach and the greater part of the intestine; and the "post-abdomen," having the reproductive organs and the heart. In the "Didemniens" there are only two regions—thorax and abdomen—the reproductive organs and heart being placed on the intestine. In the third group, the "Botrylliens," the viscera form a single mass in which the alimentary canal lies alongside the branchial sac. The first and last tribes are natural groups, and correspond respectively to the modern families Polyclinidæ and Botryllidæ, but the second tribe, the Didemniens, is rather too wide in its range, and includes forms which are not closely related. Milne-Edwards, however, subdivides it into two groups, the "unistellés" and the "bistellés," of which the former is a very natural group, the modern family Didemnidæ.

This arrangement of the Ascidiæ Compositæ was generally accepted until 1872, when Giard published an important memoir,[1] in which he gave a classification based mainly upon the method of gemmation. He divided the Synascidiæ (in which he included the Social Ascidians of Milne-Edwards) into three great groups—(1) the Catenatæ, in which the buds are formed at the base or posterior end of the body; (2) the Glomeratæ, in which the buds are developed from the region of the reproductive organs of the parent; and (3) the Reticulatæ, in which the buds are formed as outgrowths from the part of the body where the thorax and abdomen join.

The group Catenatæ includes three families, the Clavelinidæ, the Perophoridæ, and the Botryllidæ, but M. Giard gives no sufficient reasons for placing the first two families in the Compound Ascidians, and as von Drasche has since pointed out, the third one does not really exhibit the essential character of the Catenatæ. The second group, the Glomeratæ, corresponds to Milne-Edwards' "Polycliniens," in addition to his "Didemniens bistellés," and is divided into two families, the Polyclinidæ and the Distomidæ, both of which are still retained, but have undergone some changes in constitution. The "Didemniens unistellés" correspond to Giard's third group, the Reticulatæ, and are characterised by gemmation taking place from the region at the posterior end of the branchial sac and by exhibiting the phenomenon of embryonic blastogenesis. This is a natural enough section, which includes two distinct families, the Didemnidæ and the Diplosomidæ, which Milne-Edwards to a certain extent confused with one another. The Glomeratæ cannot stand without several changes which have since been made by von Drasche, and which really reduce it merely to Milne-

[1] Recherches sur les Ascidies Composées ou Synascidies.

Edwards' section "Polycliniens." Giard's memoir contributed largely to the knowledge of the Compound Ascidians, especially in regard to methods of gemmation, but his classification did not make much advance upon that of Milne-Edwards.

Della Valle, writing in 1877, accepts Giard's arrangement with one change which is of importance. In the Catenatæ he places *Diazona* as a third family, the Diazonidæ, in addition to the three, Perophoridæ, Clavelinidæ, and Botryllidæ, recognised by Giard.

We come now to Dr R. von Drasche, the latest authority on the Compound Ascidians, who, both in his preliminary note published in 1882 and in his detailed memoir on the Synascidiæ of the Gulf of Rovigno, wisely abstains from any attempt to form great divisions, and merely groups the genera in a series of carefully chosen families. Of these, the Botryllidæ correspond to Milne-Edwards' old section "Botrylliens," while the Didemnidæ and Diplosomidæ are identical with Giard's families bearing the same names. The Polyclinidæ and the Distomidæ do not correspond exactly to any of Giard's families, but the former are Milne-Edwards' "Polycliniens" without change.

A new family, the Chondrostachyidæ, has been formed for the reception of Macdonald's *Chondrostachys* and von Drasche's *Oxycorynia*, remarkable forms in which the Ascidiozooids are all placed upon a common peduncle penetrated by large vascular canals. I am not inclined to admit the necessity for this new family, and a number of the most interesting new forms obtained during the Challenger Expedition are intermediate, I believe, between von Drasche's *Oxycorynia* and Della Valle's *Distaplia*, and so bridge over the gap between the Chondrostachyidæ and the Distomidæ as defined by von Drasche. The two remaining families of von Drasche's system, the Clavelinidæ and the Perophoridæ, are, I consider, more closely allied to the Simple than to the Compound Ascidians. The genus *Diazona* I regard as a connecting link between the Clavelinidæ and the Chondrostachyidæ, and I find myself unable to decide whether it should be placed amongst the Simple or the Compound Ascidians. After all it is a matter of secondary importance where exactly the artificial line separating the two groups should be drawn.

Several new genera have been added by the Challenger investigations, but they nearly all find places in some of the above mentioned families. One of the most remarkable is *Cœlocormus*, for which a new family, the Cœlocormidæ, must be instituted. I have added, also, a second new family, the Polystyelidæ, formed for the reception of Giard's genera *Polystyela* and *Synstyela*, and some allied forms, all of which have up till now been regarded as Simple Ascidians, along with some new species obtained during the Challenger Expedition. My reasons for taking this step, and an account of the probable affinities of the group, will be given further on in the Report (p. 322, and Summary).

Dr von Drasche does not define the Synascidiæ, and from one or two passages in his memoir it seems probable that he is in very much the same position in which I now find myself, viz., unable to detect any character or combination of characters which will serve

to distinguish Simple from Compound Ascidians. Reproduction by gemmation and the formation of colonies in the latter group will not hold, since it is possible to pass from *Ciona*—a typical Simple Ascidian—to *Distoma* and the very centre of the Compound Ascidians through the following series of forms which show a perfect gradation of these characters:—*Ciona*, *Rhopalæa*, *Ecteinascidia*, *Clavelina*, *Diazona*, *Chondrostachys*, *Oxycorynia*, *Distoma*.

The formation of common cloacal cavities, canals, and apertures cannot be considered as a diagnostic feature of the Compound Ascidians. Although recent investigations by Giard and others upon living material have demonstrated their presence in some genera in which they were previously unknown, yet there are some forms considered by all authorities as Synascidiæ, such as *Chondrostachys*, *Diazona*, *Distoma*, and others, in which the atrial apertures of the Ascidiozooids open independently on the surface of the colony, and no common cloaca is formed.

Lastly, we come to characters taken from the condition of the test, but these break down like the others. In the first place, in passing along the series of forms mentioned above as connecting *Ciona* and *Distoma*, we encounter all stages between a distinct test or tunic for each individual and a common mass in which a number of Ascidiozooids are imbedded. And, secondly, the remarkable group of Polystyelidæ, which were briefly characterised by Giard in 1874, present many of the characters of highly differentiated Simple Ascidians (the Cynthiidæ) along with the supposed Synascidian feature of a colony composed of many Ascidiozooids completely buried in a common test.

Thus all the diagnostic features usually employed fail utterly, and we find that, as our knowledge of the two groups extends, it becomes more and more difficult to distinguish even in an artificial and arbitrary manner between Simple and Compound Ascidians. The condition of the test is probably the best distinguishing feature to employ, but it must be remembered that, as I have just shown, it will not hold good in all cases. As a general rule, however, in the Ascidiæ Compositæ the Ascidiozooids forming the colony have not separate tests, but are imbedded in a common investing mass, while in the Ascidiæ Simplices, when colonies are formed, the Ascidiozooids remain partially distinct from one another and each retains its own test.

The mutual relation of the different families of the Ascidiæ Compositæ is a very difficult matter to determine on account of the peculiarity of their evolution. They seem to form, when expressed diagrammatically, a network rather than a tree-like figure, and this is due, I believe, to the group being formed of several distinct branches which have arisen at different times from different groups of the Simple Ascidians and have become modified so as to form, in some cases, divergent and in others convergent lines. This will be discussed more fully further on in the Report in considering the phylogeny of the group, and the arrangement of the various families according to their natural affinities may be postponed till then (see Summary and General Remarks).

The order in which the families and genera are placed in the following systematic part of this Report is, as a lineal arrangement always must be, more or less artificial. I have followed, as a general rule, the order adopted by von Drasche with the few modifications indicated in the criticism of his arrangement given above, and with the addition of the groups now formed for the reception of the species new to science.

Family I. Botryllidæ.

Colony usually thin and incrusting, sometimes in the form of thick fleshy masses.
Systems circular, elliptical, or forming branched lines. Common cloacal openings distinct, usually lobed.
Ascidiozooids short, and not divided into regions.
Test usually soft, traversed by numerous vessels with large terminal knobs.
Branchial Sac large and well developed, internal longitudinal bars present, stigmata numerous.
Dorsal Lamina in the form of a plain membrane.
Tentacles simple, not more than sixteen in number.
Alimentary Canal placed alongside the posterior part of the branchial sac.
Reproductive Organs on both sides of the body.
Gemmation lateral, from the bodies of the Ascidiozooids; and also stolonial, from the ectodermal processes or vessels in the test.

This family occupies the highest position amongst Compound Ascidians on account of the considerable differentiation attained by most of its members. It corresponds to Savigny's genus *Botryllus*,[1] and to Milne-Edwards'[2] two genera *Botryllus* and *Botrylloides*, but was not raised to the rank of a family until the publication of Giard's work upon the Synascidiæ in 1872.[3] Since that date it has been regarded as a well-marked family by all writers, and has been discussed in particular by Della Valle[4] and by von Drasche.[5]

As first defined by Giard in 1872, the Botryllidæ included only thin incrusting colonies, but if the forms included in the modern genera *Polycyclus* and *Sarcobotrylloides* are to be retained in the family—a matter in regard to which there can be no doubt—the amended definition given by von Drasche, and allowing of the admission of thick fleshy colonies, must be accepted. All conditions between the very thin and delicate

[1] Mémoires sur les Anim. sans Vert., 2e Partie, 1re fasc., tableaux systematique, p. 197, Paris, 1816.
[2] Observations sur les Asc. Comp., &c., *Mém. Acad. Sci. Paris*, t. xxviii., 1842.
[3] Recherch. sur les Asc. Comp., &c., *Archives d. Zool. expér.*, t. i. p. 616, 1872.
[4] Contribuzioni alla storia naturale delle Ascidie Composte del Golfo di Napoli, &c., Napoli, 1877.
[5] Die Synascidien der Bucht von Rovigno, Wien, 1883.

gelatinous films formed by some species of *Botryllus*, and great thick lobed solid masses as in *Sarcobotrylloides*, may be found, and they all belong to the family Botryllidæ.

The systems vary greatly in shape in the different genera, but they are always conspicuous, and usually clearly defined (see Fig. 7, p. 35). The common cloaca of the system is usually large and conspicuous, even in spirit specimens. It has a more or less well-marked membranous margin and is frequently lobed, a lobe corresponding to each Ascidiozooid in the system.

The Ascidiozooids are distinctly marked on the outside of the colony, and are characterised by their short and undivided bodies, showing no distinction between branchial and visceral regions such as is found in most other Compound Ascidians. The branchial aperture is described by von Drasche as "toothless" in his definition, but this cannot be accepted as an invariable characteristic, as *Botrylloides purpureum* has the branchial aperture distinctly lobed (see p. 43 and Pl. II. fig. 7, *br*). The atrial aperture is generally provided with a single lobe or projecting languet which joins the membranous margin of the common cloaca.

The common test is soft and gelatinous. It is usually very transparent, and contains a great many branched "vessels" or ectodermal processes from the Ascidiozooids containing blood and ending in swollen knobs or bulbs. The branchial sac is always of very large size, larger than in any other family of the Ascidiæ Compositæ. It extends over the entire length and breadth of the body of the Ascidiozooid, the alimentary and reproductive viscera being placed alongside it. There are usually about twelve rows of stigmata, and at the middle of the series there are from ten to thirty in each row. The dorsal lamina is a plain narrow membrane which may be corrugated, but has no distinct teeth nor ribs. The tentacles are not large, and never exceed sixteen in number. They may be reduced to two. Four larger and four smaller, placed alternately, is the characteristic arrangement.

The alimentary canal lies on the side of the posterior one-third or one-fourth of the branchial sac, and is mainly directed transversely. The stomach is large, and is usually globular in shape. It is folded longitudinally. On each side of the body, about the middle, lies the ovary, more or less surrounded by the spermatic vesicles. Thus two hermaphrodite genital glands are present. Gemmation usually takes place from the sides of the Ascidiozooids, but in *Sarcobotrylloides* at least buds may also be formed in the dilatations on the ectodermal processes or vessels of the common test (see Pl. IV. fig. 13). Consequently the lateral budding can no longer be regarded, as it was by von Drasche, as a diagnostic feature of the Botryllidæ, although it is certainly the characteristic method of reproduction by gemmation in the family. The exceptional method found in *Sarcobotrylloides* will be discussed at length further on (see p. 59).

Lamarck[1] in 1815 formed the genus *Polycyclus* for a Botrylloid species producing a thick fleshy colony. This genus was not recognised by Savigny, who in 1816[2] divided the single genus *Botryllus* into two sections :—(1) "Botrylli stellati" having the Ascidiozooids of each system placed in one row, and (2) "Botrylli conglomerati," where the Ascidiozooids form several rows. The latter included only one species, *Botryllus conglomeratus*, Gaertner, said to be found on the English coast. There is considerable doubt as to this species. Possibly it does not belong to the Botryllidæ.[3] Savigny further divided the Botrylli stellati into—(1) those where the Ascidiozooids are cylindrical and have the branchial and atrial apertures close together, and where the margin of the common cloaca is not distinct; and (2) those where the Ascidiozooids are ovoid and have the apertures distant, and where the margin of the common cloaca is always visible. This was a very natural classification, and it has been upheld by almost every writer on the Botryllidæ

FIG. 7.—A Colony of a Compound Ascidian (*Botryllus*). The Ascidiozooids are arranged in eight systems.

a, a large system formed of fifteen Ascidiozooids; *b*, a small system formed of seven Ascidiozooids; *c*, the test or investing mass; *d*, a common cloacal aperture; *e*, an Ascidiozooid; *f*, the terminal knobs of the vessels; *g*, a system where the common cloacal aperture is fully expanded.

since. Milne-Edwards recognised the value of the distinction, and in 1841[4] raised the two groups to generic rank by founding the new genus *Botrylloides* for Savigny's first tribe of species; *Botryllus* being restricted to the second series of forms. As Giard and others have pointed out, these two genera differ not only in the shape of the Ascidiozooids and in the common cloacal aperture, but also in the shape of the systems composing the colony (compare Fig. 7 with Fig. 8, D and E, p. 39).

Della Valle[5] showed in 1877 that Lamarck's old genus *Polycyclus*, which, although it had been employed by some authors (*e.g.*, Risso,[6] Delle Chiaje,[7] and Grube[8]), was by no

[1] *Mém. Mus. Hist. Nat. Paris*, t. i. p. 340.

[2] Mémoires sur les Anim. sans Vert.

[3] From the description and figure given by Pallas (Spicilegia Zool., fasc. 10, Berolini, 1774, p. 39, Tab. iv. fig. 6) it is evident that the animal in question is a Compound Ascidian; it is, however, impossible to say with any certainty even the family to which it belongs. The figure seems to me much more like one of the Polyclinidæ than one of the Botryllidæ. It is not unlike a small colony of *Amaroucium proliferum*. Consequently, I think Savigny's second section may be regarded as having been probably founded upon a mistaken identification, and may now be suppressed.

[4] Observations sur les Asc. Comp., &c.

[5] Contrib. alla Storia Nat. d. Asc. Comp., &c., p. 22.

[6] *Mém. Mus. Hist. Nat. Paris*, 1826, t. iv. p. 280.

[7] Descriz., &c., vol. iii. p. 19.

[8] Die Insel Lussin, &c., p. 64, Breslau, 1864.

means generally accepted, was really worthy of being regarded as a distinct genus. Della Valle consequently divided the family into three genera:[1] *Botryllus*, *Polycyclus*, and *Botrylloides*. In his elaborate work on the Compound Ascidians of the Gulf of Rovigno, published in 1883, von Drasche adds a fourth group, *Sarcobotrylloides*, for forms which bear the same relation to *Botrylloides* that *Polycyclus* does to *Botryllus*. His classification of the Botryllidæ is as follows:—

Family.	Genus.	Subgenus.
Botryllidæ.	*Botryllus*,	*Polycyclus*.
		Botryllus.
	Botrylloides,	*Sarcobotrylloides*.
		Botrylloides.

This arrangement seems to agree fairly well with the present knowledge of the group, and as the specimens in the Challenger collection can all be referred to one or other of these groups, the only modification which I suggest is that the four subgenera should be regarded as distinct genera. They seem to me to be nearly equidistant from one another, and I think it would be quite as natural to unite *Polycyclus* and *Sarcobotrylloides*, the two massive groups, and distinguish them from *Botryllus* and *Botrylloides*, the two incrusting groups, as to adopt von Drasche's arrangement. Consequently it seems better to avoid the unnecessary complication of recognising groups of two ranks between the species and the family, and simply to consider the Botryllidæ as including four genera:—

Botryllus, Gaertner and Pallas.
Polycyclus, Lamarck.
Botrylloides, Milne-Edwards.
Sarcobotrylloides, von Drasche.

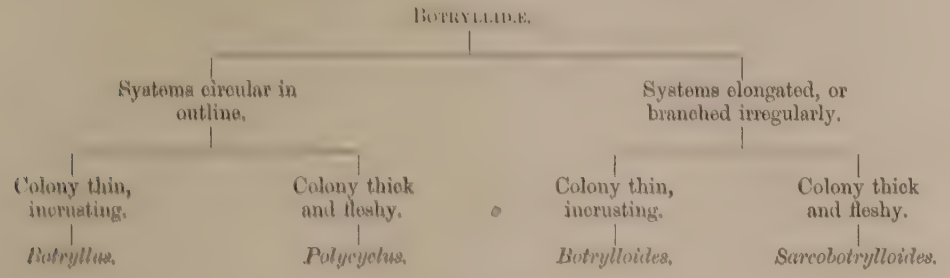
It is a remarkable fact that the common genus *Botryllus* is not represented by any specimens in the Challenger, "Porcupine," or "Lightning" collections. This is partially explained by *Botryllus*, in the restricted sense, being almost entirely a shallow water genus, most of the known species being found at or about low water mark on coasts, while the dredging operations of these expeditions were mainly carried on in deep water; still a good deal of shallow water investigation was done by the Challenger at some localities, such as Port Jackson, Kerguelen Land, the Philippine Islands, and Japan, and the total absence of species of *Botryllus* from the collections seems to indicate that that genus is by no means so abundantly represented in other parts of the world as it is on the north-western coasts of Europe.

Sarcobotrylloides and *Polycyclus* occur in the "Porcupine" collection, but all the Challenger Botryllidæ belong to the genus *Botrylloides* in the restricted sense. On the

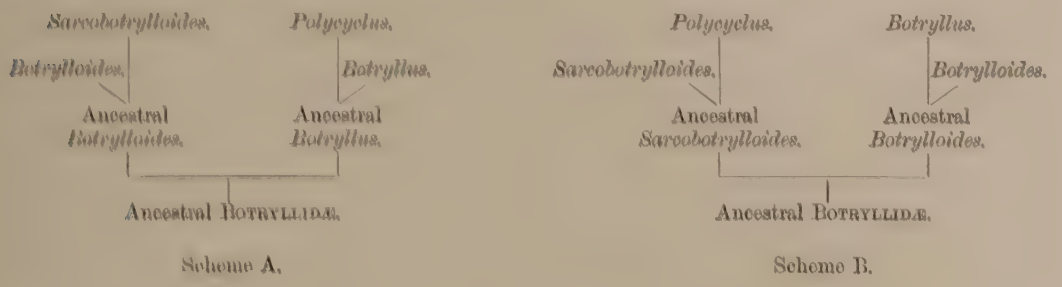
[1] He calls them subgenera, but treats them as genera.

whole the Botryllidæ are feebly represented in the collections compared with most of the other groups and compared with the part they play in the British Ascidian fauna.

The four genera may be distinguished by the following characters :—



It is a difficult question to determine whether, in the ancestral history of the group, the modification of the systems or of the colony took place first, whether, in fact, Scheme A or Scheme B most nearly represents the phylogeny of the family.



It must also be left doubtful whether in Scheme A the thin (*Botryllus*) or the thick (*Polycyclus*) condition of the colony was the more primitive; and whether, in Scheme B, the irregular (*Botrylloides*) or the regular (*Botryllus*) condition of the system was the more primitive. Probably both in the case of the colony and of the system the extreme forms which we see at the present day diverged from intermediate forms; and the ancestral *Botryllus* of Scheme A formed a moderately thick colony, which might become reduced into a *Botryllus* or increased to form a *Polycyclus*, while the ancestral *Botrylloides* of Scheme B had an irregular arrangement of Ascidiozooids, which became modified on the one hand into regular circular systems as in *Botryllus*, and on the other hand into long branching lines as in *Botrylloides* (see Fig. 8, D and E, p. 39).

Botrylloides, Milne-Edwards.

Botryllus, Savigny, Mémoires, &c., 1816. In part.
Botrylloides, Milne-Edwards, Observations, &c., 1842. In part.
Botrylloides, Forbes and Hanley, British Mollusca, 1853. In part.
Botrylloides, Alder, Ann. and Mag. Nat. Hist., 1863. In part.
Botrylloides, Giard, Recherches, &c., 1872. In part.
Botrylloides, Della Valle, Contribuzioni, &c., 1877. In part.
Botrylloides, von Drasche, Synascidien, &c., 1883, p. 15.

Colony thin, incrusting, and usually gelatinous.
Systems elliptical, or elongated, forming branched and sometimes anastomosing lines.
Ascidiozooids cylindrical, with the apertures placed near one another on the anterior end.
Test soft and gelatinous, never much thickened, penetrated by many vessels.
Branchial Sac long and well developed.
Alimentary Canal placed alongside the branchial sac at its posterior end.
Reproductive Organs placed on both sides of the body near the posterior end.

This genus is distinguished from *Botryllus* and from *Polycyclus* by the shape of the systems, which may be of any form so long as they are not regular and circular; and from *Sarcobotrylloides* and *Polycyclus* by the colony forming a thin crust and not a solid mass. In this restricted sense *Botrylloides* has been used by von Drasche, while all other writers since Milne-Edwards (1842) include in it forms with a thickened test and massive colonies (*Sarcobotrylloides*, von Drasche).

Savigny, as Giard has pointed out, really indicated this genus in 1816 by dividing his species of *Botryllus* into sections, of which his first tribe corresponds exactly to Milne-Edwards' *Botrylloides*. No one, however, seems to have considered the group of species worthy of generic rank until Milne-Edwards in 1842 founded the genus *Botrylloides* for Savigny's first tribe of *Botrylli* and some new species which he described and figured in his great work on the Compound Ascidians of the English Channel. Since then many new species have been described, chiefly by Alder, Giard, and Della Valle.

I have adopted von Drasche's separation of the thin incrusting forms from those producing thick masses (*Sarcobotrylloides*), as it is certainly a convenient distinction and one which deserves to be recognised as much as does the similar character distinguishing *Botryllus* from *Polycyclus*.

The systems of *Botrylloides* are usually very irregular, but have a characteristic appearance (see Fig. 8, D and E, p. 39, and Pl. I. Figs. 1, 4). They are formed generally of several lines extending in different directions from a common place, and in some cases branching and anastomosing. The Ascidiozooids border these lines, and are therefore placed in more or less parallel double rows. The following diagrams (Fig. 6)

show how a complicated system might be produced by a series of gradual changes from the simple stellate system of a *Botryllus*. They are all forms which are frequently seen in examining a number of colonies of different ages of a common *Botrylloides* (*e.g.*, *Botrylloides rubrum*, Milne-Edwards).

A shows a system like that characteristic of *Botryllus* and *Polycyclus*, composed of a few Ascidiozooids arranged radially around a circular common cloaca, so as to produce

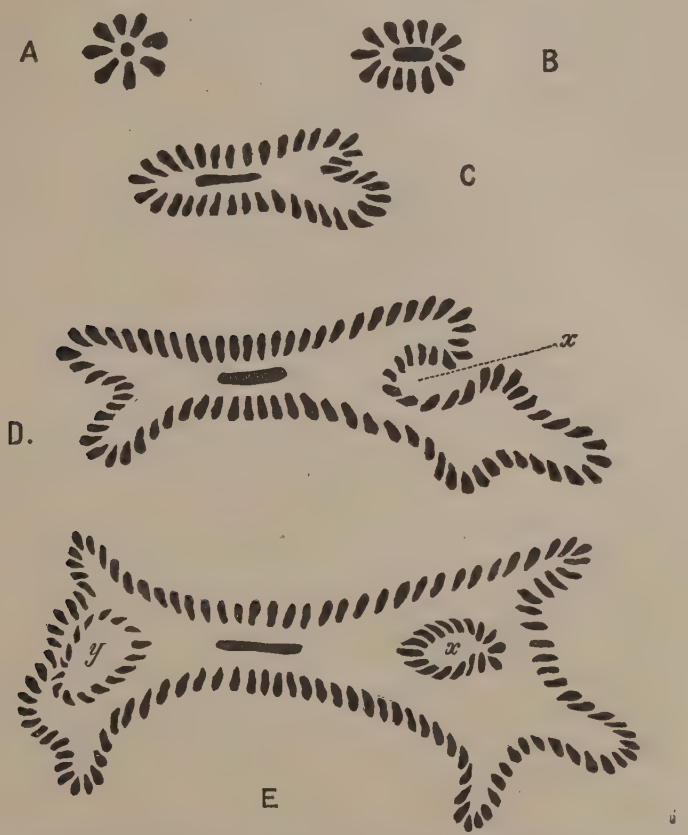


FIG. 8.—Diagrams showing how a simple circular system (A) may develop through (B) and (C) into the condition characteristic of the systems in the genus *Botrylloides*, such as (D) and (E).

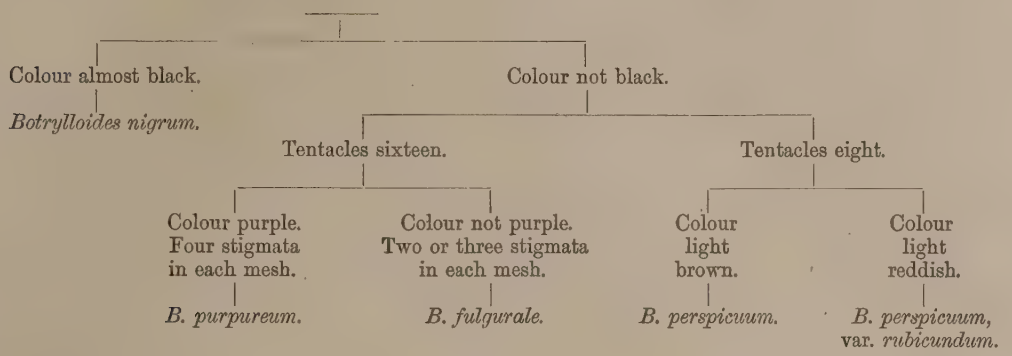
a stellate figure. In B the system has become elongated, the Ascidiozooids are more numerous, and the common cloaca is elliptical. This condition may sometimes be seen in species of *Botryllus*, and it is common in young colonies of *Botrylloides*. In C the system has become much larger and the number of Ascidiozooids is greatly increased. Each end of the formerly elliptical system has become enlarged, and one of them is commencing to fork or divide into two branches. D shows a still larger and

more complicated system, where the branches at the right hand end have increased considerably and are beginning to fork in their turn. In E, finally, an anastomosis has been effected between two of the secondary branches at the right hand side of the system so as to produce an island of common test (*x*, *y*) surrounded by a ring of Ascidiozooids. Such an island (which is very commonly seen in large colonies of *Botrylloides*, see Pl. I. fig. 4) is entirely different from a simple system such as A or B, not only in mode of formation but also in structure. In the first place it contains no common cloaca, and in the second place the surrounding Ascidiozooids are placed so that their ventral edges face inwards, while in the simple system (A or B) the dorsal edges of the Ascidiozooids are nearest to the centre of the space. This arrangement is obviously a result of the mode of formation of the "island," which is morphologically outside the system although enclosed by a part of it. It is, therefore, not at all surprising to find that such islands usually contain numbers of "terminal knobs" like those found in the colonial test outside the systems and forming the edges of the colony (see Pl. I. figs. 2, 5). Even more complicated conditions than that shown in E are found in old colonies of *Botrylloides*, but they are all produced in the manner which has been indicated by irregular branching and anastomosing.

The other characters by which the typical *Botrylloides* differs from the typical *Botryllus*, viz., the shape of the Ascidiozooid, its position in the test, and the situation of its apertures, may, I think be regarded as the natural result of the modification of the system which has just been traced. In *Botryllus* each Ascidiozooid in the system has its atrial aperture opening directly into the circular centrally placed common cloacal aperture, and therefore the body must be placed with its long axis directed radially, and the atrial aperture must be situated at the central (morphologically posterior and dorsal) end, far from the branchial aperture, in order that it may reach to the common cloaca. Hence in *Botryllus* the Ascidiozooids lie with their ovate bodies horizontal (*i.e.*, the antero-posterior axis is parallel with the upper surface of the colony), and the apertures are distant. Now when the system became much elongated it would clearly be impossible for the Ascidiozooids at a distance from the common cloaca to have their atrial apertures opening directly into that cavity, so they came to communicate with canals continued outwards through the test, from the common cloaca, one in each branch of the system. Such an arrangement would not only do away with any necessity for radial extension in the body of the Ascidiozooid, but would, by bringing the common cloaca (in the shape of its prolongation the canal) closer to the body, tend to cause the branchial and atrial apertures to come nearer. As a result of this we find in *Botrylloides* the cylindrical Ascidiozooids placed more or less vertically (*i.e.*, with the antero-posterior axis perpendicular to the surface of the colony), and with the apertures close together at the anterior end of the body.

In the collections there are four species and a well-marked variety of *Botrylloides*;

they are all new to science. One of the species was obtained during the "Lightning" expedition of 1868, the others are all Challenger specimens. The following scheme gives, in brief, the distinguishing characters of these new forms.



The specimen which is described under the name of *Botrylloides fulgurale* was obtained during the "Lightning" expedition of 1868, from a depth of 530 fathoms. This is probably the greatest depth at which a *Botrylloides* has been found.

Botrylloides purpureum, n. sp. (Pl. I. figs. 1, 2, and 3; and Pl. II. figs. 1–11).

The Colony is irregular in shape, large and spreading, and of moderate thickness. The surface is rather uneven, but smooth. The colour is a dark purple. A lighter area is found around the anterior ends of the Ascidiozooids and at the edges of the colony, which in some places become colourless and transparent. The common cloacal apertures are fairly numerous and conspicuous.

The length of the colony is about 7·5 cm., the breadth about 6 cm., and the average thickness about 2 mm.

The Ascidiozooids are elongated antero-posteriorly, being about 2 mm. in length and rather less than 1 mm. in greatest breadth. The anterior end, which is visible on the surface of the colony as a circular rather light coloured area, is about 1 mm. in diameter.

The Test is soft but firm. In no part does it become thick. On its thin expanded edges, at the margins of the colony, it is transparent and colourless or of a pale grey hue, elsewhere it is light purple. The terminal knobs of the vessels are not very conspicuous. They are of moderate size and of a dark purple colour. In sections the test is seen to be formed of a homogeneous matrix in which numerous minute rounded and fusiform cells are scattered. It is penetrated in all directions by numerous ramifying and anastomosing vessels with swollen terminations.

The Mantle is thin, but moderately muscular. It is very transparent. The muscle bands are very narrow, and run most of them in a transverse direction.

The Branchial Sac is of considerable size and fairly strong. The transverse vessels are narrow and all of one size. The internal longitudinal bars are of moderate strength. They are rather irregular in their course. The meshes are slightly elongated transversely, and contain each about four stigmata.

The Endostyle is narrow, but is conspicuous through the mantle. It is long and straight.

The Dorsal Lamina is a plain membrane with neither marginal teeth nor transverse ribs. It is usually, however, somewhat corrugated or crimped at its margin.

The Tentacles are sixteen in number. Four are very long and meet in the centre of the branchial aperture when laid flat. Four others alternating with these are about half as long, while the remaining eight are very short.

The Dorsal Tubercle is a small aperture with prominent edges placed a short distance in front of the anterior end of the dorsal lamina. There is usually no well-marked peritubercular area.

Locality.—Station 208, January 17, 1875; lat. 11° 37′ N., long. 123° 31′ E.; depth, 18 fathoms; bottom, blue mud.

Only one specimen of this large and handsome species was obtained. It occurs growing over a very irregularly shaped mass of sponge trawled from 18 fathoms, at Station 208, near the Philippine Islands. The colour is a striking feature (Pl. I. fig. 1), and is probably not very different from what it was when living. The darkest areas are those which lie between the rows of branchial apertures and are formed by the posterior parts of the Ascidiozooids. The anterior ends are decidedly lighter coloured (Pl. I. figs. 2, 3), and show the circular open branchial apertures clearly. Under a lens or low power objective they also show the anterior extremity of the endostyle (Pl. I. fig. 3), the peripharyngeal band, the nerve ganglion, and an inner circle, which seems to be the line of insertion of the sixteen tentacles, having four marks, placed, one dorsally, one ventrally, and two laterally—these are probably the bases of the four largest tentacles. Further from the branchial aperture may be noticed three short radially directed lines upon each side; these are probably the anterior extremities of the internal longitudinal bars of the branchial sac. Over the whole of this anterior end of the Ascidiozooid little clumps of pigmented blood-corpuscles may be found scattered irregularly. From this description of the figure (Pl. I. fig. 3) it is obvious that a considerable amount of the anatomy of the Ascidiozooid may be made out simply from a surface view slightly enlarged. This is very rarely the case with alcoholic specimens of Compound Ascidians.

In some parts of the colony the Ascidiozooids are arranged in small nearly circular or elliptical systems, which suggest the arrangement in the genus *Botryllus*, but in other

parts of the colony (Pl. I. figs. 1, 2) the systems are large, irregular, and ramifying, as is usually the case in *Botrylloides*. The elongated shape of the Ascidiozooid (Pl. II. fig. 7), so characteristic of *Botrylloides*, places the matter beyond all doubt.

The terminal knobs of the vessels in the test, which sometimes form so conspicuous a feature in the external appearance of the colony in the Botryllidæ, are in the present species small and only visible on close inspection. They are of a dark purple colour, and only show clearly on the thin expanded edges of the colony, where the test is transparent. In such places they are fairly numerous (Pl. I. figs. 1, 2). The common cloacal apertures, which are widely open, are of irregularly elliptical shape, and of a very dark purple colour. The common test attains no great thickness in any part of the colony. At its thickest place it is scarcely 4 mm., twice the ordinary thickness of the colony. In some places the colony is much thinner than 2 mm., and on certain parts of the edges becomes merely a delicate expanded membrane formed entirely by the test.

In its minute structure this is simply a typical Botryllid test. The soft homogeneous matrix is seen in sections (Pl. II. fig. 1) to contain numbers of small dots, which under a higher power (see Pl. II. fig. 2, *t.c.*) are seen to be cells, all much of the same size but varying considerably in shape, the commonest forms being circular, ovate, fusiform, and triangular. Vessels are abundant, but of rather small size. They branch and anastomose freely, and frequently present dilatations upon their course or expand into terminal knobs often of irregular shape (Pl. II. fig. 1, *t.k.*), though usually more or less ovate. These knobs invariably contain blood-corpuscles, which are also commonly found in the vessels (Pl. II. fig. 2).

The piece of mantle which is figured (Pl. II. fig. 3) shows the mainly transverse direction in which the thin muscle bands run, and their characteristic method of dividing and joining with branches from adjacent bands. Each band is composed of at most a very few muscle fibres, frequently of one only, and these fibres show very clearly their origin from fusiform cells, which have become greatly elongated. The nucleus of the cell is in most cases still visible in a spindle-shaped swelling near the middle of the fibre. The rest of the mantle is formed of connective tissue, a clear homogeneous matrix, containing numerous scattered corpuscles of various shapes, and penetrated by lacunæ in which blood-corpuscles lie. In the figure (Pl. II. fig. 3) the fusiform nucleated swellings on the muscle fibres, the connective tissue cells, and the blood-corpuscles are represented.

The body of the Ascidiozooid (see Pl. II. fig. 7) is considerably elongated even for a *Botrylloides*. It is about two and a half times as long as it is broad. The mantle is slightly six-lobed at the branchial aperture, and is sufficiently transparent to show clearly the endostyle (Pl. II. fig. 7 *en*), the entire alimentary canal (*œ*, *st*, *i*, and *r*), the reproductive organs (*g*), and in some places the stigmata of the branchial sac.

The branchial sphincter is feebly developed. In the branchial sac a notable feature is the slight calibre of the transverse vessels (Pl. II. figs. 4 and 5, *tr*). In most places they

are no larger than the fine longitudinal vessels. The stigmata are a little irregular in form and by no means very large. The cells bearing the cilia (Pl. II. fig. 5, *sg. c.*) are cubical or short columnar in form and distinctly nucleated.

The endostyle, though narrow, is very conspicuous. Its edges are prominent, and at the anterior end are seen distinctly (Pl. II. fig. 6) to become continuous with the peripharyngeal band. At each side of the endostyle there is a widish area (about the size of a small mesh) of the branchial sac free from stigmata.

The dorsal lamina commences anteriorly as an extremely narrow membrane which rapidly widens (Pl. II. fig. 8, *d.l*). In some cases it appears to have transversely directed ribs or bands, but a careful examination always shows that they are merely corrugations or folds. The peripharyngeal band connecting the anterior ends of the endostyle and dorsal lamina circumscribes an oval area (Pl. II. fig. 8), inside which lies the circle of sixteen tentacles. The four largest tentacles are placed dorsally, ventrally, and laterally. There is no well-marked peritubercular area, and the dorsal tubercle, which is very simple, appears to vary somewhat in its position, size, and shape. Figure 8 shows a case where the tubercle is circular, very small, and placed close to the dorsal lamina, leaving a wide expanse of prebranchial zone between itself and the dorsal tentacle. In the specimen represented by figure 9 the tubercle was somewhat ovate in form with a slight constriction in the middle; it was also of larger size, and was placed about one third of the way from the dorsal lamina to the dorsal tentacle. In this last figure (Pl. II. fig. 9) the specimen is represented as seen from the outer surface (*i.e.*, from the mantle), and therefore the dorsal lamina is hidden by the nerve ganglion and neural gland (*n.g.*). The duct (*gl.d.*) leading from the dorsal tubercle to the neural gland is well seen.

The alimentary and reproductive viscera lie alongside the posterior third or so of the branchial sac (Pl. II. fig. 7). The œsophagus is rather long, and is abruptly curved in the middle of its course. It runs at first posteriorly and dorsally and then ventrally, and a little posteriorly. The stomach (*st*) is the most posterior part of the canal. It is large, equally wide at both ends, and strongly ribbed longitudinally. The intestine (*i*) runs at first ventrally, then anteriorly, then dorsally, and a little ventrally towards the œsophagus. It then curves anteriorly to become the rectum (*r*), which runs anteriorly and terminates in a wide anal aperture, about half way down the body. The course of the intestine is, as a whole, transverse and parallel to the stomach, and it therefore forms a right angle with the rectum, which runs antero-posteriorly.

The genital gland (*g*) is situated in front of the intestine, not far from the ventral edge. It is an irregularly lobed (Pl. II. fig. 10) opaque mass. The other genital gland is placed on the inner face of the mantle in the corresponding position on the other side of the body.

Figure 11 shows a young Ascidiozooid, many of which are found in various stages of development lying in the test alongside the older Ascidiozooids from which they have

budded. It is seen from the dorsal edge, and shows the mantle (*m*), the branchial sac, the prebranchial area in front bounded by the peripharyngeal bands, the œsophagus, stomach (*st*) and intestine, and the two genital glands (*o*), which in these buds are always filled with ova of various sizes, some of them apparently mature or almost so. The genital glands in the adult Ascidiozooid, on the contrary, show no ova, and appear to be merely testes. It is pretty certain, therefore, that protogyny occurs here as in many other Compound Ascidians, and that each Ascidiozooid produces ova in its genital gland when young, and spermatozoa only when fully developed. In this way cross fertilisation is effected, the ova of the younger members of the colony being fertilised by the spermatozoa of the older ones.

Botrylloides perspicuum, n. sp. (Pl. I. figs. 4, 5 ; and Pl. III. figs. 9–14).

The Colony is lobed, but not very irregular in form ; it is rather thick. The surface is slightly uneven, but smooth. The general colour is a light brown, with a greyish-blue tinge in places. The anterior ends of the Ascidiozooids are light grey, but opaque. The edges of the colony, composed of test only, are a transparent grey, while the bodies of the Ascidiozooids cause the remainder of the colony to appear of a grey-brown colour with a slight tinge of purple. The common cloacal apertures are fairly numerous and conspicuous.

The length of the larger colony is 4 cm., the greatest breadth 3 cm., and the average thickness about 4 mm.

The Ascidiozooids are elongated antero-posteriorly and placed at right angles to the upper surface of the colony. Each is about 2 mm. in length and less than 1 mm. in its greatest breadth. The light coloured anterior end visible on the surface is about 0·5 mm. in diameter.

The Test is firm and in some places rather thick. At the margins of the colony, where free from Ascidiozooids, it is transparent, and almost colourless or of a pale grey hue. Elsewhere it seems of a pale bluish-purple colour. The terminal knobs of the vessels are very conspicuous in most parts of the colony. They are numerous and of a purplish-brown colour. In some places, however, especially along the edges of the colony, they are of a light grey colour. The matrix of the test is homogeneous and compact; it contains the usual small ovate and fusiform cells. Vessels are numerous and branch freely, especially near the surface and edges of the colony. The swollen terminations are very large, and usually more or less spherical in form ; they contain many pigmented corpuscles of a brownish-purple colour.

The Mantle is thin and very slightly muscular. It contains a number of large pigmented cells scattered through it.

The Branchial Sac is large. The transverse vessels are of moderate breadth and all

of the same size. Usually there are three internal longitudinal bars on each side. The stigmata are of moderate size and regularly placed; there are usually three in a mesh.

The Dorsal Lamina is a plain membrane.

The Tentacles are eight in number, four long and four short, placed alternately.

The Dorsal Tubercle is a small ovate aperture with prominent edges placed in the middle of the dorsal part of the prebranchial zone. There is a shallow peritubercular area.

Locality.—Station 212, January 30, 1875; lat. 6° 54′ N., long. 122° 18′ E.; depth, 10 fathoms; bottom, sand.

Two colonies of this species were obtained near the Philippine Islands from a depth of 10 fathoms. The dimensions of the larger colony are given in the above description. Those of the smaller one are:—length about 3 cm., breadth about 2·5 cm., thickness 1 to 3 mm.

The colour varies considerably in different parts of the colony (see Pl. I. fig. 4). The free edges formed by test only are a transparent light grey marked with more opaque ashy grey spots where the terminal knobs of the vessels are present. The anterior ends of the Ascidiozooids are almost white, but quite opaque. The circular, open, branchial apertures are clearly visible to the eye. The remainder of the colony is darker, and is in some places of a purplish-brown colour, while in others it has a slight bluish tinge. The colour is due to the pigmented cells in the mantle around the lower parts of the Ascidiozooids, and in the swollen ends of the vessels in the test.

The colonies of this species are of such very considerable thickness[1] (see Pl. I. fig. 4) that at first glance they are liable to be taken for a *Sarcobotrylloides*, but, on cutting into the colony, it is found that it is not a solid mass, but merely a comparatively thin layer incrusting a core formed of sand-grains, shell fragments, and Annelid tubes.

The Ascidiozooids, in their arrangement, form the long winding rows characteristic of *Botrylloides*, and these rows, in some parts of the colony, bound comparatively large (such as 7 mm. by 5 mm.) elliptical or quadrate spaces free from Ascidiozooids and formed of test richly provided in its surface layer with brown-coloured terminal knobs of vessels. A similar arrangement is found in colonies of *Botrylloides gascoi*, Della Valle, from the Bay of Naples. The last species, however, differs entirely in colour and other particulars from the one under consideration.

Under a strong lens or a low power of the microscope (1 inch) the anterior part of the endostyle, the peripharyngeal band and the nervous mass are readily seen around the open branchial apertures. The terminal knobs of the vessels also form a conspicuous feature in such a surface view of the colony. They surround the Ascidiozooids on all sides (Pl. I. fig. 5), and give the colony a variegated appearance on account of some

[1] The measurements of the thickness given in the description are not the total thickness of the mass, including the sand and other foreign bodies, but merely the distance from the upper to the lower surface of the test as seen in a vertical section.

of them containing more pigmented corpuscles than others. The common cloacal apertures are usually slightly stellate or lobed in form when not opened to the full extent. Their membranous edges are richly provided with purplish-brown pigment corpuscles (Pl. I. fig. 5).

The cells of the test are small and inconspicuous. The matrix though generally homogeneous is in some places finely fibrillated. The vessels form a very prominent feature (see Pl. III. figs. 9, 10) with their numerous branches and large globular terminal knobs. The pigment corpuscles are large, circular, ovate, or elliptical in shape, and contain (Pl. III. fig. 12) fine reddish-brown pigment particles which are frequently placed entirely, or almost entirely, in one half of the cell.

The mantle, although it appears very thin and slight, contains many muscle bands, but they are very fine. The large pigmented cells form almost a continuous layer in some parts of the mantle and agree exactly in structure with those found in the vessels of the test (Pl. III. fig. 12). They are particularly well seen in sections stained in aniline blue, where the red-brown cells stand out well against the blue ground formed by the remainder of the mantle.

The branchial sac (Pl. III. fig. 11) is long and narrow, and is of a brown colour, due to the pigmented corpuscles. The transverse vessels are considerably broader than in the last species (*Botrylloides purpureum*), and contain muscle fibres. In one young specimen examined there were three internal longitudinal bars on the one side of the sac and four on the other. This specimen had fourteen rows of stigmata on each side, that is, there were thirteen transverse vessels. Another specimen, fully developed, but young, showed thirteen rows of stigmata on a side. There are usually ten to twelve stigmata in a row about the middle of the sac.

The endostyle is narrow and not very prominent. Its groove is deep and the columnar cells are fairly long. As usual, a series of very long cilia projects from the centre of the groove (see Pl. III. fig. 13). The dorsal tubercle is placed rather further forward than is usual. Directly behind it lies a large elliptical opaque yellowish-brown mass, formed by the nerve ganglion and the neural gland. In some specimens the smaller tentacles are absent, so that the number is reduced to four; while in others, although eight are present, they are all very short.

The alimentary canal is confined to the posterior region of the Ascidiozooid. The œsophagus runs posteriorly and ventrally and is moderately long (Pl. III. fig. 14, *œ*). It has no marked angle. The stomach is large and is strongly ribbed externally, especially at the œsophageal end, which is truncated and much wider than the opposite end where the stomach tapers somewhat suddenly into the intestine. There are usually five projecting folds on each side of the stomach. The intestine (Pl. III. fig. 14, *i*) curves anteriorly, and then dorsally, and a little posteriorly to touch the anterior edge of the stomach. It then turns dorsally and anteriorly to become the rectum, which, after

a very short course, ends not far in front of the œsophageal aperture. The anus has a slightly thickened band on the margin, but is not lobed or fringed in any way. In some specimens the intestine is wider than is shown in the figure (Pl. III. fig. 14), and is then evidently dilated by its contents.

Botrylloides perspicuum, var. *rubicundum*, nov. (Pl. I. figs. 6, 7 ; Pl. III. figs. 15–18).

The Colony is small, rounded or ovate, slightly lobed and moderately thick. The surface is somewhat uneven, but smooth. The general colour is a light reddish-purple in the centre, and white or grey round the edge. The anterior ends of the Ascidiozooids are slightly lighter. The common cloacal apertures are inconspicuous.

The length is 1·5 cm., the breadth 1 cm., and the average thickness about 3 mm.

The Ascidiozooids are elongated antero-posteriorly and placed at right angles to the surface of the colony. Each is about 2 mm. in length and about 0·7 mm. in greatest breadth. The anterior end is about 0·5 mm. in diameter.

The Test is firm, but soft. At the margins of the colony it is nearly transparent and usually of a light grey colour. In some places it is almost white. Elsewhere it is coloured by the Ascidiozooids. The terminal knobs of the vessels are in some places yellow and conspicuous. In other parts they are of a greyish colour like the test or slightly more opaque. The matrix of the test is homogeneous and very transparent in sections. The test cells are very minute and inconspicuous ; vessels are numerous and branch freely, especially near the surface and edges of the colony. The terminal knobs are large and more or less globular or ovate in form. They contain many corpuscles, some of which are coloured with a pale yellow pigment.

The Mantle is extremely thin and delicate.

The Branchial Sac is large. The transverse vessels are all of the same width. There are three internal longitudinal bars on each side. The stigmata are regularly placed, there are two or three in each mesh.

The Dorsal Lamina is a plain membrane.

The Tentacles are eight in number, four long and four short, placed alternately.

The Dorsal Tubercle is a small ovate aperture with prominent edges placed in the middle of the dorsal part of the prebranchial zone.

Locality.—Station 212, January 30, 1875 ; lat. 6° 54′ N., long. 122° 18′ E. ; depth, 10 fathoms ; bottom, sand.

The above description refers to half a dozen small colonies growing over lumps of sand, Annelid tubes, shell fragments, &c., dredged near the Philippine Islands, from a depth of 10 fathoms.

Several of the colonies are about the size given above ; the smallest is 5 mm. in length and 3 mm. in breadth.

The colour of the part of the colony where Ascidiozooids are present is pretty uniformly of a reddish-purple (Pl. I. figs. 6, 7), while the edges where the test is free from Ascidiozooids is greyish, marked in places either with yellow dots, or opaque grey dots. The anterior ends of the Ascidiozooids, although lighter than the rest of the body, are not nearly so light as in *Botrylloides perspicuum*. From all this it is obvious that the present specimens differ considerably from *Botrylloides perspicuum* in external appearance (compare Pl. I. fig. 4 with Pl. I. figs. 6, 7), but on account of the great similarity in their internal structure I have placed them under the latter species as a variety, until the examination of additional specimens of both forms gives us a more complete knowledge of the range of individual variation, and of the exact colouring of the colonies in the living condition.

Although the colonies of the variety are all of small size, still one can see from the arrangement of the Ascidiozooids in the systems that it is a *Botrylloides*. The lines, however, are not so long and winding as in *Botrylloides purpureum*, and no large spaces are enclosed by them as in *Botrylloides perspicuum* and *Botrylloides gascoi*.

The cells of the test are very inconspicuous, and the matrix is homogeneous and transparent. The vessels are numerous but delicate. Their terminal knobs, which are found chiefly close to the surface, vary greatly in form and size (Pl. III. fig. 18, *t.k.*). They are sometimes globular, sometimes ovate, and sometimes of an elongated pyriform shape, and occasionally very irregular. The pigmented corpuscles are not so large as in *Botrylloides perspicuum*, and they are of a pale yellow colour. The mantle is only slightly pigmented. In some cases it is scarcely coloured at all.

The branchial sac (Pl. III. fig. 15) is very like that of *Botrylloides perspicuum*. It is large and has many rows of regularly placed stigmata. There are usually four or five stigmata between the endostyle and the most ventral of the internal longitudinal bars. The endostyle is narrow.

The dorsal tubercle (Pl. III. fig. 16, *d.t.*) is exactly like that of *Botrylloides perspicuum*, and occupies a position unusually far from the dorsal lamina.

The alimentary canal (Pl. III. fig. 17) occupies only the posterior part of the Ascidiozooid. The œsophagus runs posteriorly and ventrally, and is moderately long. The angle varies somewhat in different individuals (compare figs. 14 and 17 in Pl. III.). The stomach is large and is strongly ribbed externally, especially at the œsophageal end, which is truncated and wider than the opposite end which tapers suddenly into the intestine (Pl. III. fig. 17, *i*). There are usually five projecting folds on each side of the stomach. The intestine curves anteriorly and then dorsally and a little posteriorly to come in contact with, and in some cases (Pl. III. fig. 17) considerably overlap, the anterior edge of the stomach. It then turns dorsally and anteriorly to become the rectum, which after a very short course ends not far in front of the œsophageal aperture.

Botrylloides nigrum, n. sp. (Pl. I. fig. 8; Pl. III. figs. 19–21).

The Colony is of irregular shape, flat, and spreading. The surface is uneven and moderately smooth. The colour is almost black except at the edge of the colony, where it is a little lighter. The common cloacal apertures are rather inconspicuous.

The length of the colony is about 7 cm., the breadth about 1·5 cm., and the average thickness about 2 mm.

The Ascidiozooids are elongated antero-posteriorly, being about 1·5 mm. in length and about 0·5 mm. in breadth. In thin parts of the colony their anterior parts show on the surface as dark areas less than 1 mm. in greatest diameter.

The Test is soft even in its thickest parts. On its thin expanded edges it is of a greyish colour and semi-transparent, elsewhere it is dark and opaque. The terminal knobs of the vessels are conspicuous in the thin marginal portions of the test as black, ovate or elongated markings. The test has a gelatinous homogeneous matrix in which numerous very minute cells are scattered thickly. Vessels are abundant and their swollen ends are very thickly placed close to the surface around the Ascidiozooids.

The Mantle is very thin and delicate. In some parts it is transparent, in others pigmented; the musculature is very slight.

The Branchial Sac is long and narrow. There are three internal longitudinal bars upon each side. The transverse vessels are rather narrow and are all of the same width. The meshes are nearly square, and contain each two or three stigmata.

The Dorsal Lamina is a plain membrane.

Locality.—Near the Island of Bermuda.

One large and a couple of small colonies of this species were obtained growing over Annelid tubes and Ascidians[1] from shallow water off Bermuda. The dimensions given in the above description are those of the large colony.

The dark colour is a striking feature (see Pl. I. fig. 8). In the thicker central parts of the colony it is almost black. In other parts it is of a dark earthy colour, while the expanded edges of the colonies are somewhat variegated, the greyish or opaque white test being marked with numerous black spots caused by the terminal knobs of the vessels. In the middle of the dark area formed by each Ascidiozooid is found, on close examination, a white spot, in the centre of which is seen the open circular branchial aperture.

Under a lens very little of the structure of the Ascidiozooid can be made out from the surface. The deeply pigmented mantle forms the dark area, which varies considerably in size and shape in the case of different Ascidiozooids. It is generally more

[1] Specimens of *Clavelina oblonga* (see Part I. of this Report, vol. vi. part xvii. p. 246).

or less elliptical or ovate, and a little less than 1 mm. in its greatest extent. The light mark surrounding the branchial aperture is caused by a band of opaque white pigment in the part of the mantle forming the branchial siphon. The anterior extremity of the endostyle is occasionally visible in the external view of the animal.

The Ascidiozooids are not always placed with their long axis perpendicular to the surface of the colony. In fact, in the thinner parts they always lie more or less flat, and there is considerable irregularity in their arrangement, the systems being difficult to trace, and recalling somewhat the arrangement in some groups of the Didemnidæ. The variegated or speckled appearance of the marginal regions of the colony free from Ascidiozooids is due partly to the presence of large numbers of vessels with their terminal knobs filled with black pigment corpuscles, and partly to a certain amount of opaque white pigment, both colours showing clearly against the semi-transparent grey of the test. In the greater part of its extent the large colony is thin, but in two or three places it has become considerably thickened, up to 4 mm. The smaller colonies are thin throughout; one measures 2 cm. in its greatest extent, and the other 6 mm.

The test is very soft and gelatinous. The matrix is perfectly transparent. The cells though minute are very numerous, and the vessels are abundant. Their terminal knobs are large, and the pigmented corpuscles which they contain are also large. The latter are ovate in shape and have the black pigment usually in one half only of the cell. They are exactly like the pigment cells of *Botrylloides perspicuum* (see p. 47 and Pl. III. fig. 12), except that the pigment granules in that case are brown. Besides these dark pigmented cells there are also in the terminal knobs a number of yellowish and of transparent corpuscles which are rather smaller but otherwise similar to the pigmented cells.

The mantle, where free from pigment, is perfectly transparent; but in the greater part of most Ascidiozooids pigment cells like those of the vessels in the test are very abundant, scattered through the connective tissue. Transverse muscle bands are present, but they are very delicate and quite colourless. The body of the Ascidiozooid when removed from the test is long and narrow, and the part occupied by the branchial sac is usually somewhat curved, with the concavity on the dorsal surface.

The transverse vessels of the branchial sac are narrow but have each a few muscle fibres (Pl. III. fig. 20, *tr.*). There are usually ten or twelve rows of stigmata in the branchial sac, and two or three stigmata in each mesh (Pl. III. fig. 19). The area lying between the endostyle and the most ventrally placed of the internal longitudinal bars has four or five stigmata. In some sacs the stigmata are short and wide (as shown in Pl. III. fig. 20). The endostyle is long and rather narrow, and is perfectly straight.

The alimentary canal forms a more rounded mass than usual. The œsophagus is wide and very short (Pl. III. fig. 21, *œ.*), and runs almost directly ventrally to open into the wide dorsal end of the stomach. The stomach is large, and has nearly the form of an

equilateral triangle in side view. The dorsal end is the widest part, and has five or six lobes upon each side. From the grooves between these lobes the channels, corresponding to the ridges on the inner surface, converge towards the narrow intestinal end. On the anterior surface of the stomach, about two-thirds of the way from the œsophagus to the intestine, there is a large ovate thick-walled cæcum (Pl. III. fig. 21, *cæ.*) into which the duct of a gland placed on the walls of the intestine opens. Beyond this cæcum the stomach tapers into the intestine, which turns anteriorly and dorsally, then a little posteriorly towards the œsophagus, and then finally curves sharply forward to become the short rectum. At its commencement the intestine is narrow, in its forward curve it widens, and then in its second or rectal bend it narrows again, and the rectum is the narrowest part of the alimentary canal (Pl. III. fig. 21).

The intestinal gland is composed of a number of clear tubules, which form a network over the last portion of the intestine. The duct springs from the posterior side of that region, and runs ventrally and posteriorly to open by a dilated end into the cæcum on the anterior wall of the stomach (see Pl. III. fig. 21). This system is the same as the so-called liver of many Tunicata, and the system in *Perophora* and *Salpa*, discussed by Chandelon,[1] and the refringent tubules described by Giard[2] in many Compound Ascidians, and the more posterior of the two glandular systems which I have figured in *Doliolum*.[3]

Many tailed larvæ occur in some parts of the colony. They have rounded or elliptical bodies about 0·42 mm. antero-posteriorly, and the tail measures about 0·8 mm. in length. In these larvæ there is only a single pigmented sense-organ present.

Botrylloides fulgurale, n. sp. (Pl. III. figs. 1–8).

The Colony is a large regular spreading mass of considerable thickness. The surface is uneven but smooth. The colour varies from buff to light brown, and has in places a slight pinkish tint. The anterior ends of the Ascidiozooids form lighter areas, and the edges of the colony are light grey. The common cloacal apertures are inconspicuous.

The extreme length of the colony is about 8·5 cm., the greatest breadth 4·5 cm., and the average thickness about 4 mm.

The Ascidiozooids are elongated antero-posteriorly, and are about 3 mm. in length and very nearly 1 mm. in greatest breadth. The light coloured area visible on the surface of the colony is rather less than 1 mm. in its greatest diameter.

The Test is rather hard, firm, and tough. It does not become excessively thickened in any part. There is very little expanded edge, the margins of the colony being comparatively thick and rounded, and of a greyish colour. The terminal knobs of the

[1] Sur une annexe, &c., *Bulletin de l'Acad. Roy. de Belgique*, t. xxxix., No. 6, 1875.

[2] Recherches sur les Synascidies, *Arch. de Zool. expér.*, t. i. p. 536.

[3] Report upon the Tunicata collected during the Cruise of H.M.S. "Triton," *Trans. Roy. Soc. Edin.*, vol. xxxii. pt. i. p. 93.

vessels are very inconspicuous. They are small and of a greyish colour, and are only abundant at the free edges. The test is formed of a homogeneous matrix in which small cells are scattered. These are not very numerous. In sections the vessels are fairly numerous, and their enlarged terminal knobs are abundant in the lower part of the colony and in the test lying between the Ascidiozooids.

The Mantle is moderately strong, and is very transparent. The muscle bands are narrow and are mostly transverse in direction.

The Branchial Sac is large, and the stigmata are numerous. There are three internal longitudinal bars on each side. The transverse vessels are moderately wide and not all of the same size. The meshes are square, and contain two or three stigmata each.

The Dorsal Lamina is perfectly plain.

The Tentacles are sixteen in number, eight long and eight short, placed alternately.

The Dorsal Tubercle is a circular opening with prominent edges placed about one-third of the way from the dorsal lamina to the tentacles. It is rather large. There is no peritubercular area.

Locality.—Station 12 of "Lightning" Expedition; lat. 59° 36′ N., long. 7° 20′ W.; bottom temperature, 6°·4 C.; depth, 530 fathoms.

One specimen [1] of this species was obtained during the cruise of H.M.S. "Lightning" in the summer of 1868 between Scotland and the Færöe Islands at Station 12,[2] depth, 530 fathoms. It is attached to a fragment of a large Lamellibranch shell, around which it has grown in such a manner as almost to cover the shell completely (Pl. III. fig. 1). The colour is pale and looks bleached, very possibly it was much brighter when living. The areas between the rows of Ascidiozooids are of a light brown colour, the edges of the colony where formed of test only are greyish, and the anterior ends of the Ascidiozooids are of a pale buff colour, and show clearly, when closely examined, the open circular branchial apertures.

Under a lens or low power objective the open branchial apertures are conspicuous objects, each surrounded by an opaque whitish region, the branchial siphon and sphincter (Pl. III. fig. 5, *sph.*). The anterior extremity of the endostyle is also clearly seen, and in some cases the peripharyngeal band and the nerve ganglion. The branchial aperture is frequently elliptical in shape, being elongated in a dorso-ventral direction (see Pl. III. fig. 5). Between the Ascidiozooids some of the vessels of the test can be made out, and occasionally terminal knobs are visible.

In one or two places the Ascidiozooids are arranged in small circular systems as in *Botryllus*, but over the greater part of the colony the systems are long and winding

[1] This specimen had been deposited along with some more of the "Lightning" material in the British Museum, and I am indebted to Dr. Günther for having placed the specimen at my disposal for description here along with the "Porcupine" and Challenger Compound Ascidians.

[2] Station 12 of the "Lightning," not the Challenger, series. For further particulars see Depths of the Sea, p. 81.

(see Pl. III. fig. 1). The vertical position and the shape of the Ascidiozooids are like those in a typical *Botrylloides*.

The test is of a pale buff colour in most of its extent. It is slightly lighter and more transparent on the margins. It attains no great thickness in any part, but forms an even layer over both surfaces of the incrusted shell. In vertical sections the vessels and their terminal knobs appear to be more abundant in the lower part of the test and between the Ascidiozooids than on the upper surface. This is rather a puzzling circumstance, and is apparently incapable of explanation according to my view[1] that these vessels and terminal knobs have a respiratory function. Possibly their curious arrangement in this species is due to the fact that there is comparatively little test on the upper surface of the colony, as the Ascidiozooids are numerous and closely placed, while on the surface at the posterior ends of the Ascidiozooids there is a thickish layer of test in which lie most of the vessels and their terminal knobs, and a number of buds and young Ascidiozooids. The terminal knobs are in some places, especially at the sides of the Ascidiozooids, exceedingly plentiful on the ends of the vessels, from which they bud off in all directions (see Pl. III. fig. 2). In some cases the terminal twigs are like small bunches of grapes.

The cells in the homogeneous test matrix are neither of large size nor very abundant. The turning in of the test to line the branchial siphon is very clearly seen both in a surface view and in vertical sections. Figure 5 on Plate III. shows the appearance presented in a surface view with Swift's 1-inch objective of a specimen stained in picro-carmine, from the outside. The dark band (*sph*) is the sphincter muscle, and the test is seen to form fifteen or sixteen lobes, where it turns in to line the aperture. In vertical sections these lobes can be traced down to the anterior edge of the tentacles (Pl. III. fig. 4).

The mantle is very like that of *Botrylloides purpureum*. The branchial sac is large, and is elongated at right angles to the surface of the colony. Some of the transverse vessels are wider than others, but there is no regularity in their arrangement. A few muscle fibres are generally to be seen in the transverse vessels. The internal longitudinal bars are strong (Pl. III. fig. 3, *i.l.*), and are slightly thickened at their points of union with the transverse vessels, but there are no papillæ. In a fully developed sac there are at least twelve rows of stigmata, and there are twelve to fourteen stigmata in the largest rows.

The endostyle is large and conspicuous (Pl. III. fig. 4, *en.*). The dorsal lamina is very distinctly ciliated along its free margin (Pl. III. fig. 8, *d.l.*). The tentacles (Pl. III. figs. 4 and 7, *tn.*) are regular in their alternating sizes and arrangement.

The dorsal tubercle is rather larger than usual (Pl. III. figs. 7, 8, *d.t.*). Its edges are formed of low columnar cells with cilia directed inwards towards the centre of the opening. In some specimens, as shown in the figure (Pl. III. fig. 7), the neural canal

[1] On a New Organ of Respiration in the Tunicata, *Proc. Lit. and Phil. Soc. Liverpool*, vol. xxxix. p. 39, 1884.

can be distinctly seen leading posteriorly from the dorsal tubercle to the opaque region at the anterior end of the dorsal lamina occupied by the ganglion and neural gland. The dorsal tubercle is unusually far from the peripharyngeal band (Pl. III. fig. 7). There is no peritubercular area, which is just what would be expected from the anterior position of the tubercle.

When cut in vertical section (see Pl. III. fig. 8) the opening of the tubercle is seen to lead into a wide ovate cavity lined by columnar epithelium provided with very long cilia bent downwards or from the opening. This cavity is continued in the form of a funnel into a narrow duct which leads to the neural gland placed upon the anterior surface of the nerve ganglion. The figure (Pl. III. fig. 8) shows a section from the prebranchial zone (*z.*) just behind the base of the tentacles to the dorsal lamina (*d.l.*). The epithelium of the prebranchial zone and of the dorsal lamina is cubical or low columnar and ciliated. There is a deep ciliated groove at the anterior end of the dorsal lamina and immediately behind the peripharyngeal band (*p.p.*). On the peripharyngeal band the epithelium becomes more columnar and the cilia rather longer, and it remains in the same condition on the edges of the opening of the dorsal tubercle. On the wall of the ovate cavity (*inf.*) the cells are still more columnar, and the cilia are extraordinarily long; they meet in the centre of the cavity, and then bend backwards so as to point towards the narrow duct behind. The walls of the duct are formed of cubical epithelium provided with short cilia. The gland is formed by short branched cæca which open into a space continuous with the lumen of the duct. In the figure they are seen cut at various angles; their walls are formed by cubical non-ciliated cells with distinct nuclei.

The nerve ganglion (*n.g.*) lies immediately posterior to the gland, and is very opaque. Nerve cells are seen over the outer surface. The connective tissue of the mantle in which the ganglion and neural gland lie is a clear homogeneous matrix with variously shaped connective tissue cells scattered through it. Rounded, fusiform and stellate forms are most abundant. Here and there in small sinuses are found blood-corpuscles, and a few muscle fibres (*m.f.*) extend upwards from the muscular part of the mantle further back.

The alimentary canal has much the same appearance and takes much the same course as in *Botrylloides perspicuum*. The œsophagus is long, and is curved with the convexity dorsal. The stomach is wide at the dorsal end and narrow at the ventral, where it passes gradually into the intestine. There are ten folds projecting into the interior of the stomach and visible as channels on the exterior, five on each side. The intestine curves anteriorly and then dorsally, and after running along the anterior edge of the stomach to the œsophagus it turns anteriorly again to become the short rectum. In some specimens the first portion of the intestine is much swollen with food.

There is an irregularly stellate (Pl. III. fig. 6) or lobed genital gland on each side of the posterior part of the branchial sac. In the fully developed Ascidiozooids this gland

is composed of testes only, while in young buds a series of ova, one or two of which appear mature, occupy the same region. This species, therefore, like some others, is protogynous (see p. 45).

Sarcobotrylloides, von Drasche.

Sarcobotrylloides, von Drasche, Die Synascidien der Bucht von Rovigno, Wien, 1883, p. 14 (as a subgenus).

Colony thick and fleshy, often lobed.

Systems elliptical, or elongated, forming branched and sometimes anastomosing lines.

Ascidiozooids cylindrical, with the apertures placed near one another on the anterior end.

Test gelatinous, rather solid and greatly thickened, many vessels present.

Branchial Sac large and well developed.

Tentacles eight to sixteen in number.

Alimentary Canal placed alongside the posterior part of the branchial sac.

Reproductive Organs placed on both sides of the body near the posterior end.

This genus was instituted by von Drasche in 1883 as a subgenus of *Botrylloides*, for the reception of a species bearing the same relation to other species of *Botrylloides* that *Polycyclus* does to *Botryllus*. As I have stated before (p. 38), I consider *Sarcobotrylloides* sufficiently well characterised to be raised to generic rank, and I am glad to be able to add a second species which is quite as distinct as *Sarcobotrylloides superbum*, von Drasche, from members of the allied genus *Botrylloides*.

Colonies of *Sarcobotrylloides* form thick solid masses, which may be irregularly lobed on the outside, or produced into processes.

The systems are precisely like those of the genus *Botrylloides*. The Ascidiozooids occupy only the outer parts of the colony, the centre being formed by a solid mass of test, penetrated by vessels which may have dilatations in which buds are produced. In shape and anatomy the Ascidiozooid is almost exactly like that of *Botrylloides*.

The new species described below was obtained during the cruise of H.M.S. "Porcupine" in 1869, half way between the Butt of Lewis and the Færöe Isles, at a depth of 363 fathoms, a very considerable depth for one of the Botryllidæ to inhabit. It differs from von Drasche's species (*Sarcobotrylloides superbum*), the only other known species of the genus, in many particulars. The colour of the colony as a whole, and of the several parts, is quite different in the two species; the test, for example, is opaque white in *Sarcobotrylloides superbum*, and of a pale pink or light purple colour in *Sarcobotrylloides wyvillii*. The common cloacal apertures are stated by von Drasche to be few but large, with projecting margins. In the "Porcupine" specimen none are visible, still this is

probably due in great part to the contracted condition of the colony, caused by preservation in alcohol. The Ascidiozooids are very much shorter antero-posteriorly in *Sarcobotrylloides wyvillii* than in *Sarcobotrylloides superbum*, and are less regularly arranged in systems (compare Pl. IV. fig. 12 with von Drasche's figure). There are only eight tentacles in *Sarcobotrylloides superbum*, while *Sarcobotrylloides wyvillii* has sixteen. This list of the more notable differences—there are others of less importance—shows clearly that these forms constitute two well-marked species.

I have named the new species *Sarcobotrylloides wyvillii* in honour of Sir Wyville Thomson, who dredged it in the "cold area" of the Færöe Channel[1] close to the famous "Wyville Thomson" ridge. This region has since been investigated by Mr. Murray and Captain Tizard in the "Knight Errant" (1880)[2] and the "Triton" (1882), but no Compound Ascidians were obtained during these expeditions.

Sarcobotrylloides wyvillii, n. sp. (Pl. IV. figs. 12–18).

The Colony is of an irregular elongated form and of considerable thickness. The surface is somewhat uneven, but smooth. The colour varies from pale pink to light purple. The anterior ends of the Ascidiozooids form lighter areas, and the basal part of the colony is light grey and semi-transparent. The common cloacal apertures are inconspicuous.

The length of the colony is 4·3 cm., the breadth is 1·6 cm., and the thickness is 1·3 cm.

The Ascidiozooids are elongated antero-posteriorly, being about 1·5 mm. in length, and rather less than 1 mm. in greatest breadth. The light area formed on the surface of the colony by the anterior end of the Ascidiozooid is about 0·5 mm. in diameter.

The Test is soft but moderately firm. It is very thick all over the colony. At the narrow base it is light coloured and semi-transparent, elsewhere, as seen from the surface, it is opaque and of a pale bluish-pink or very light purple colour. No terminal knobs of vessels are visible. The test is formed of a homogeneous transparent matrix, in which numerous rounded fusiform and stellate cells are imbedded. The vessels are fairly abundant, but rather narrow, and they do not branch much. The terminal knobs are not very abundant, except just under the surface.

The Mantle is thin but fairly muscular. The muscle bands are mostly transverse in direction, and are very delicate.

The Branchial Sac is of moderate size. There are three internal longitudinal bars on each side. The transverse vessels are moderately wide, and are all of the same size. stigmata are regular, and are usually about four in a mesh.

The Dorsal Lamina is a plain membrane.

[1] See Depths of the Sea, Third Cruise of the "Porcupine" in 1869, p. 104. London, 1873.

[2] See *Proc. Roy. Soc. Edin.*, vol. xi. p. 638, 1882.

The Tentacles are rather large. There are sixteen, eight long and eight shorter, placed alternately.

The Dorsal Tubercle is a simple rounded opening placed not far behind the base of the tentacles.

Locality.—Station 54 (of the third cruise of H.M.S. "Porcupine" in the summer of 1869); lat. 59° 56′ N., long. 6° 27′ W.; bottom temperature −0°·3 C. ("cold area" of Færöe Channel); depth, 363 fathoms.

Only one specimen referable to the genus *Sarcobotrylloides* is in the collection. It was dredged during the cruise of H.M.S. "Porcupine" in 1869, at Station 54, from a depth of 363 fathoms. It is an irregularly elongated mass (Pl. IV. fig. 12), which has grown over and partially buried a group of Hydroid Zoophytes composed of *Sertularia operculata*, *Diphasia rosacea*, and *Campanularia volubilis*. Ascidiozooids are visible and abundant on all surfaces of the mass except a small area at the narrow lower end of the colony, near where the Zoophytes were attached. On this area the colour is a light partially transparent grey, elsewhere it is a pale pinkish or faded purple, with here and there a tinge of blue. The small anterior ends of the Ascidiozooids are lighter than the rest, and seem at first sight to be scattered quite irregularly over the surface. In some places, however, systems or parts of systems can be made out. A few of these are circular or elliptical, the rest are elongated and very irregular (see Pl. IV. fig. 12).

A surface view of the colony under a low power of the microscope reveals the minute and rather inconspicuous branchial aperture of the Ascidiozooid surrounded by an opaque white band caused by the sphincter muscle. Outside that is seen, in some cases, the peripharyngeal band and the nerve ganglion, and almost invariably the anterior extremity of the endostyle. The branchial aperture, when not circular, is frequently elongated transversely. The darkest coloured part is the region lying around and between the branchial apertures, and this owes its slightly purple tint to the lower parts of the bodies of the Ascidiozooids showing through the grey test. Here and there very fine vessels can be seen ramifying near the surface, and in some parts of the colony buds and young Ascidiozooids of a pale colour are visible.

No common cloacal apertures can be satisfactorily made out either by the eye or in a low power surface view. This is doubtless due to the contracted condition of the specimen.

The test is very thick. In a section across the colony it is seen that the Ascidiozooids occupy only a layer extending for at most 2 mm. inwards from the surface, while the whole of the centre of the mass is composed of the grey semi-transparent softish test, in which, however, many vessels and young buds are imbedded (see below).

The cells in the test are abundant and fairly large. The vessels are rather peculiar. They are abundant, but are narrower than usual and branch comparatively little, the result being that they appear in the form of long straight or winding but usually

unbranched tubes. The swollen knobs are very abundant and large in some parts of the surface layer, where they are arranged like bunches of grapes. Deeper down in the test this arrangement is never found, and most of the knobs are not terminal but occur upon the course of the vessels (Pl. IV. fig. 13), or where several intersect. In the large knobs in the surface layer blood-corpuscles are very abundant, and the knobs are flattened out parallel with and close to the surface, and altogether look like a respiratory apparatus. Those in the deeper parts, however, below the Ascidiozooids, are comparatively rarely filled with blood-corpuscles, while most of them show variously shaped masses of cells, which are undoubtedly buds in different stages of development (see Pl. IV. fig. 13, *gm.* and *gm'.*). The youngest of these, placed in small enlargements on the vessels, contain each a few blood-corpuscles and a few large cells which very soon assume the unmistakable characters of ova. These latter increase in size and slightly in number, and form the most prominent feature in all sizes of buds. In the later stages (Pl. IV. fig. 13, *gm.*) the ova occupy one end of the bud, while the rest is formed of an opaque mass of cells derived apparently from the blood-corpuscles. The whole is closely invested by the wall of the swollen vessel, which is now of considerable size.

Savigny, in his description of the marginal tubes,[1] as he called the vessels of the test in the Botryllidæ, seems to have regarded them as an apparatus for the production of buds, and this view, which was more fully elaborated and established by Milne-Edwards,[2] was generally accepted until Metschnikoff[3] and Krohn[4] in 1869 stated that the previous investigators had been mistaken, and that gemmation took place from the sides of the bodies of the Ascidiozooids, and that the marginal tubes were merely blood-vessels. Since then the vessels seem almost universally to have been regarded as having nothing to do with gemmation. Ganin,[5] however, in 1870 and Giard in 1872[6] stated that in the Botryllidæ buds might be produced in the stolons or vessels as well as from the bodies of the Ascidiozooids.

About five years ago, while working out the anatomy and histology of the genus *Colella* (see below, p. 88), I was astonished to find that there was good reason to believe that in that Ascidian at least the vessels were most directly concerned in the production of new Ascidiozooids, and that, just as in the present species, the bud was formed of elements from three sources—the wall of the vessel, blood-corpuscles, and large cells which become ova. The wall of the vessel is formed of ectoderm lined by connective tissue from the mantle, the blood-corpuscles are mesoderm cells, and the ova according to E. van Beneden's researches[7] are derived from the mesoderm. This, however, does

[1] "Tubes marginaux" and "rameaux vasculaires," Mémoires, 1816, pp. 47 and 231, pl. xxi. fig. 1.
[2] Observations, &c., 1842.
[3] Ueber die Larven und Knospen von Botryllus, *Bull. Acad. Sci. St. Petersburg*, vol. xiii. p. 293.
[4] *Archiv f. Naturgesch.*, Jahrg. xxxv. Bd. i. pp. 190 and 326.
[5] Neue Thatsachen &c., *Zeitschr. f. wiss. Zool.*, t. xx. p. 512.
[6] Recherches sur les Synascidies, *Archives d. Zool. expér.*, t. i. p. 574.
[7] *Zool. Anzeiger*, 1881, No. 88, p. 375.

not explain the origin of the endoderm tissues of the resulting Ascidiozooid, and after a careful examination I am unable to find any other elements in the young bud besides those mentioned, and yet at an early stage an inner endodermal sac is formed which afterwards develops into the branchial sac and the remainder of the alimentary canal. This endoderm layer has no connection with the wall of the vessel, and is certainly not formed from the young ova, but it is, I am convinced, derived from the blood-corpuscles. These cells, which are still primitive and undifferentiated, are usually regarded as mesodermal, but E. van Beneden[1] has shown that in the Ascidian embryo the mesoblast is formed from the primitive endoderm as two laterally placed masses of cells, some of which become blood-corpuscles. It is possible that some of these (or their descendants) may retain their endodermal characters to such an extent that when they pass into a young bud as blood-corpuscles they are still able to act as endoderm cells and form the enteron of the future Ascidiozooid. If this view be correct, then the bud is formed by cells derived, as we should expect, from all three primary layers of the body of the parent. If, on the other hand, the blood-corpuscles cannot be regarded as contributing an endodermal element, then it is by no means obvious what the endoderm tissues of the bud are derived from.

The irregular arrangement of the Ascidiozooids in *Sarcobotrylloides wyvillii*, which is rather puzzling as seen from the surface, is not so striking when viewed from the interior after the upper layer of the colony has been dissected off. Then the systems can in most places be traced, and if the top layer of test be examined from its inner surface, the places where the Ascidiozooids were placed, and their arrangement in systems more or less like those which are usually found in *Botrylloides*, can be readily made out (Pl. IV. fig. 15). In the figure the central area is formed by a thin layer of test, and has no common cloacal aperture, while the irregularly rounded projections surrounding it are parts of the regions occupied by Ascidiozooids, and have each a somewhat thickened margin formed by the test, and in some cases an adhering lining of mantle.

The mantle is much like that of the genus *Botrylloides*, but is rather more muscular. The branchial sphincter is moderately strong.

The transverse vessels of the branchial sac are rather wide, and have each a few muscle fibres. The stigmata are large and regularly arranged (Pl. IV. fig. 14, *sg.*). The endostyle is wide and thick. The tentacles are larger than is usual in the genus *Botrylloides*.

The infundibulum leading from the aperture of the dorsal tubercle, and its continuation the neural duct, are unusually distinct. The funnel is proportionally rather longer than in *Botrylloides fulgurale* (Pl. III. fig. 8), but otherwise the relations are the same. The neural gland extends for some distance beyond the opaque ovate nerve ganglion posteriorly.

The stomach is large, and is strongly ribbed on the exterior. In the young

[1] Existe-t-il un Coelome chez les Ascidies? *Zool. Anzeiger*, 1881, No. 88, p. 375.

Ascidiozooids ova are present in two masses, one on each side of the body near the posterior end, but in the fully developed condition no ova are present, and the irregularly stellate genital gland is formed entirely of spermatic vesicles.

An extraordinarily large number of tailed larvæ are present in the colony. They appear to be all at the same advanced stage of development. Only one pigmented sense-organ is present; it is placed to the left of the middle line when the body is viewed from the dorsal surface. The shape of the body of the larva varies according to the point from which it is viewed. When seen from the side (Pl. IV. fig. 17) it is equally wide in front and behind, while the dorsal or the ventral aspect shows the posterior end much narrower than the anterior (Pl. IV. fig. 16). The urochord is very distinct, and is formed of a single series of large cubical cells (see Pl. IV. fig. 18).

Polycyclus, Lamarck.

Polycyclus, Lamarck, Mém. Mus. Hist. Nat. Paris, t. i., 1815.
Botryllus, Savigny, Mém. Anim. s. vert., pp. 47, 202, 1816. In part.
Polycyclus, Risso, Hist. Nat., &c., t. iv., Paris, 1826, p. 280.
Polycyclus, Lamarck, Hist. Nat. Anim. s. vert., vol. i. p. 575, 1837.
Polycyclus, Delle Chiaje, Descrizione e Notomia, &c., t. iii. p. 19, Nap., 1841 (as a subgenus).
Botryllus, Milne-Edwards, Observations, &c., 1842. In part.
Botryllus, Forbes and Hanley, British Mollusca, vol. i., London, 1853. In part.
Botryllus, Grube, Die Insel Lussin, &c., p. 64, Breslau, 1864. In part.
Botryllus, Giard, Recherches sur les Synascidies, p. 619, Paris, 1872. In part.
Polycyclus, Della Valle, Contribuzioni, &c., p. 22, Napoli, 1877 (as a subgenus).
Polycyclus, von Drasche, Die Synascidien der Bucht von Rovigno, p. 13, Wien, 1883 (as a subgenus).

Colony thick, fleshy, and often lobed.
Systems circular in outline.
Ascidiozooids ovate, with the apertures rather distant from one another.
Test gelatinous, but solid and much thickened, vessels present.
Branchial Sac large and well developed.
Tentacles from two to sixteen in number.
Alimentary Canal placed alongside the posterior end of the branchial sac.
Reproductive Organs placed on both sides of the body near the posterior end.

This genus, although founded as far back as 1815, has been by no means generally accepted by writers on the Tunicata, most of whom have included Lamarck's species in the genus *Botryllus*.

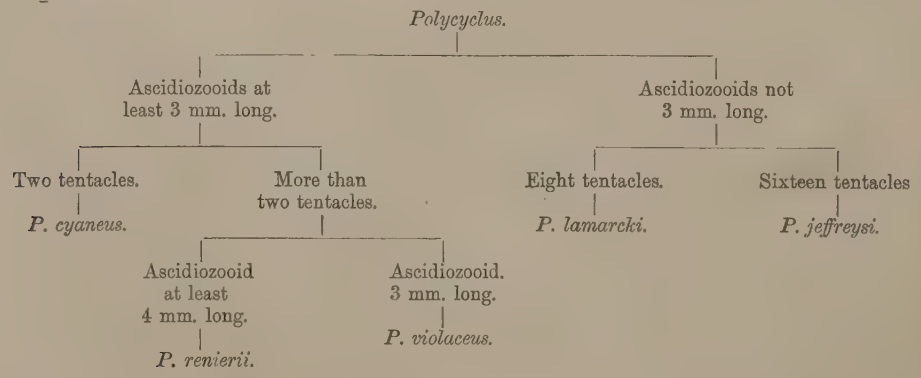
Della Valle in 1877 characterised *Polycyclus* afresh, and regarded it as being of equal rank with *Botrylloides*, both being subgenera. On the other hand, von Drasche considers *Botrylloides* as a distinct genus, and *Polycyclus* as merely a subgenus of *Botryllus*. I prefer, as explained before (p. 36), to regard these groups of species as being all of

equal rank, and I think it is simpler to call them all genera. Consequently I return to Lamarck's view, and consider *Polycyclus* as a distinct genus. It is characterised by the proportions of the colony, the shape of the systems, and the position of the apertures and form of the body in the Ascidiozooid.

The colony, like that of *Sarcobotrylloides*, is thick, forming a large and usually lobed mass in place of a thin crust as in *Botryllus* and *Botrylloides*. The systems are stellate, with circular outlines as in *Botryllus*, and thus differ from those of *Botrylloides* and *Sarcobotrylloides*. The Ascidiozooids of *Polycyclus* have the ovoid form with distant apertures, which is found in *Botryllus*. The possession of two laterally placed tooth-like tentacles is also given by von Drasche as a character of the genus, but as I do not find that feature in the new species described below, which are in all other respects typical members of the genus—I leave out this characteristic. In one of the new species the tentacles are eight in number, in the other sixteen, and in neither do two predominate over the others, consequently the tentacles of the genus must be regarded as varying from two to sixteen.

A number of species have been described which may be referred to this genus, but in the cases of the older of these it is very uncertain how far they are distinct from one another. Some of them are very imperfectly known.

Lamarck described *Polycyclus renierii*, and this is probably not the species described by Savigny as *Botryllus polycyclus*. Della Valle suggests that the *Polycyclus elongatus* of Delle Chiaje is simply a variety of *Polycyclus renierii*, a species which he describes in detail. Grube also discusses *Polycyclus renierii* and a slightly different form which he regards as a variety. Two new species, *Polycyclus cyaneus* and *Polycyclus violaceus*, were described by von Drasche in 1883. Leaving out the uncertain forms, the genus may be divided as follows :—



The two new species were both obtained during the "Porcupine" expeditions, *Polycyclus lamarcki* in the Færöe Channel from a depth of 363 fathoms, and *Polycyclus jeffreysi* from Tangier Bay in the Mediterranean, in shallow water.

Polycyclus lamarcki, n. sp. (Pl. IV. figs. 1–5).

The Colony forms a large rounded lobed mass of considerable thickness. The surface is fairly even, and is smooth. The colour is between buff and pale orange. A lighter coloured area is found in the centre of each system around the common cloacal aperture, and here and there are similar patches between the systems. The circular systems are fairly regular, but are very closely placed. The common cloacal apertures are large and conspicuous.

The length of the colony is 6 cm., the greatest breadth is 4 cm., and the average thickness about 1·5 cm.

The Ascidiozooids are elongated obliquely from the ventral part of the anterior end to the dorsal part of the posterior. On an average they are about 1·5 mm. in greatest length.

The Test is firmer than is usual in the Botryllidæ, and is greatly thickened all over the colony; where free from Ascidiozooids it is of a pale bluish-grey tint. The terminal knobs of the vessels are not conspicuous, as they are also of a greyish colour. The test is composed of a clear homogeneous matrix, in which numerous cells of various sizes and shapes are thickly scattered. The vessels are abundant and branch freely, their terminal knobs are numerous and large.

The Mantle is thin. The muscle fibres are very fine and appear to run irregularly, most of them are more or less transverse in direction.

The Branchial Sac is large and strong. The transverse vessels are rather narrow, and are all of the same size. There are three internal longitudinal bars upon each side. The meshes are about square, and contain each three stigmata. The fine longitudinal vessels are rather narrow, and the stigmata are of moderate size and regularly arranged.

The Dorsal Lamina is a plain but rather wide membrane, with its edge somewhat corrugated at the anterior end.

The Tentacles are rather short. There are only eight, and they are all of much the same length.

The Dorsal Tubercle is a very small and inconspicuous aperture placed near the anterior end of the dorsal lamina.

Locality.—Station 54 (of the cruise of H.M.S. "Porcupine" in 1869); lat. 59° 56′ N., long. 6° 27′ W.; bottom temperature —0·3° C.; depth, 363 fathoms.

This species is formed for a specimen of *Polycyclus* obtained during the cruise of H.M.S. "Porcupine" in 1869, at Station 54, in the Færöe Channel, from a depth of 363 fathoms. It is attached to and has partially grown over a colony of *Sertularia operculata*. It is irregularly lobed at the free end, and the lobes are all rounded, which gives the colony very much the appearance (Pl. IV. fig. 1) of a specimen of *Alcyonium digitatum*. The thickness is so considerable that there can be no doubt as to the propriety of separating this and similar forms from the genus *Botryllus*.

The general colour is a yellowish-brown. The Ascidiozooids, as seen on the surface, are

bright yellow, the cloacal apertures are whitish, and the surrounding area is grey, while the small intervals left here and there between the systems are of a bluish-grey tint.

The systems are very numerous, and are so closely placed over the whole colony that very little of the test is visible, and here and there it becomes a little difficult to determine where the different systems end. The systems are all nearly circular in form, and contain from eight to fourteen Ascidiozooids each; the general numbers are nine, ten, and eleven (see Pl. IV. fig. 1).

The part of the Ascidiozooid seen from the surface is of ovate form, with the narrower end pointing towards the common atrial aperture or centre of the system. It is on an average about 1·5 mm. long and 1 mm. broad, but in some places longer Ascidiozooids occur, measuring up to 2·5 mm. in length.

Under a low power of the microscope the branchial apertures, which are just visible to the unaided eye, are seen to be bounded by a rather wide opaque white band, the sphincter muscle, while a much narrower white line, the peripharyngeal band, is in most cases visible further out (compare Pl. IV. fig. 2). The anterior part of the endostyle and the nerve ganglion are also usually visible; no vessels are seen in this surface view. The common cloacal apertures are very clearly visible to the naked eye, all over the colony. They are all more or less widely open, and are bounded by distinct thickened whitish rims. They are circular or elliptical in shape, and vary in size from 0·5 mm. to 2 mm. in diameter (Pl. IV. fig. 1).

A section through the colony shows the great thickness of the test. The Ascidiozooids occupy merely a thin layer, of a yellowish colour, extending from 1 mm. to 1·5 mm. inwards from the surface; the rest of the thickness of the colony is formed of the soft grey semi-transparent test. At the lower end of the colony, near the point where the incrusted Zoophyte was attached, there is a small tapering portion of test free from Ascidiozooids. This is the only place where the terminal knobs of the vessels are visible in surface view. They are fairly numerous, but being small and of an opaque grey tint, they are by no means conspicuous. In the superficial layer of test over the colony generally, vessels are present, but they are small and their terminal knobs are of small size. This rather feeble development of vessels in the test of this species seems to be due simply to want of room in the superficial part owing to the large number of Ascidiozooids.

The mantle musculature is irregular and of fair strength. The atrial siphon is prolonged into a tube of considerable length and having a rounded termination (Pl. IV. fig. 3 *at.*). Its walls, which are simply a continuation of the mantle, are provided with both longitudinal and transverse muscle bands. The latter are more abundant and stronger than the former. The branchial aperture is very small, and the sphincter is fairly strong (Pl. IV. fig. 2, *sph.*).

The branchial sac seems stronger than is usual in the genus *Botrylloides*. In one sac examined there were ten rows of stigmata, but in some of the others there are probably

more. There are six or seven stigmata between the dorsal lamina and the first internal longitudinal bar (Pl. IV. fig. 3), and about the same number (in the middle of the sac) between the endostyle and the third bar, so that altogether there are about twenty stigmata in one of the longest rows of a fully developed sac. The stigmata are very regular, and are usually wider than the fine longitudinal vessels. They are often wider than is shown in the figure (Pl. IV. fig. 3, *sg.*). The endostyle is rather narrow.

The eight tentacles (Pl. IV. fig. 2, *tn.*) are usually all of the same length, but in some cases four of them are shorter, the long ones being the dorsal and ventral and the two median lateral tentacles. The latter pair are never larger than all the others, as they are in von Drasche's *Polycyclus violaceus*. The dorsal tubercle (Pl. IV. fig. 2, *d.t.*) is decidedly small and inconspicuous. It is placed much nearer to the dorsal lamina than to the tentacles. There is no well-marked peritubercular area. The figure formed by the peripharyngeal band is pyriform, with the narrower end ventral. The anterior extremity of the endostyle is further from the branchial aperture than the anterior end of the dorsal lamina is.

The alimentary canal is fairly compact, and lies alongside the posterior one-fourth or so of the branchial sac. The œsophagus runs posteriorly and ventrally with a slight curve. The stomach is not very large. It is ovate in shape, with the intestinal end widest. There are four or five projecting folds on each side. The intestine runs anteriorly and then turns dorsally, and, touching the anterior wall of the stomach in its whole course, reaches the œsophagus, where it turns anteriorly again and runs forwards as the rectum for a short distance along the dorsal edge of the branchial sac (Pl. IV. fig. 3, *r*). The anus opens into a considerable cloaca, the dorsal part of the peribranchial cavity, and this communicates with the common cloacal cavity of the system by the bulbous prolongation of the mantle already described (Pl. IV. fig. 3, *at.*). The anus is curiously shaped. The rectum narrows considerably at the top, to form a neck, above which the margin of the anus expands into a more or less flattened disk with an irregularly crenated margin. Figure 4 shows the top of the disk and the small puckered anal aperture as seen from above; figure 5 shows another specimen seen from the side and in optical section; while figure 3 represents in surface view, as seen from the side, an anus where the disk had only two marked crenations, thus giving it rather a bilabiate appearance.

The reproductive organs are, contrary to the rule in most of the Botryllidæ in the collection, hermaphrodite. They consist in the fully developed Ascidiozooid of one or two large yellow ova and an irregular group of spermatic vesicles. They are placed in the usual position on both sides of the body.

Polycyclus jeffreysi,[1] n. sp. (Pl. IV. figs. 6–11).

The Colony is a slightly irregular mass of moderate thickness, which has grown upwards from a narrow base. The surface is fairly even and very smooth. The colour is a light yellowish-grey on which slight brownish streaks indicate the Ascidiozooids. The base of the colony is more of a transparent grey, with numerous opaque white terminal knobs scattered over it. The circular systems are regular, and are not closely placed. The common cloacal apertures are in some places fairly conspicuous.

The length of the colony is 3 cm., the greatest breadth is 2 cm., and the average thickness about 8 mm.

The Ascidiozooids are elongated obliquely from the ventral edge of the anterior end to the dorsal edge of the posterior end, and the dorsal and anterior regions are nearest to the surface of the colony. On an average they are about 2 mm. in their greatest length.

The Test is soft inside but firm on the surface, and is considerably thickened except at the very base of the colony. Where free from Ascidiozooids it is grey and slightly transparent. At the base the terminal knobs of the vessels are very conspicuous. The test matrix is, in most places, clear and homogeneous. The cells are numerous and of various shapes. There are many irregularly stellate forms with long delicate branched rays. Vessels are not very abundant, and are rather small; their terminal knobs are large.

The Mantle is thin and membranous, and is remarkable on account of the almost total absence of muscle fibres.

The Branchial Sac is very large. There are three internal longitudinal bars upon each side. The transverse vessels are moderately wide, and are all of the same size. The meshes are elongated transversely, and each contains five or six stigmata. The fine longitudinal vessels are very narrow, while the stigmata are unusually wide. They are regularly arranged.

The Dorsal Lamina is a plain membrane. At the anterior end, which is narrow, it has a serpentine course, and its edge is usually undulating.

The Tentacles are moderately large. There are sixteen, eight long and eight short. The latter are very small, and usually irregular.

The Dorsal Tubercle is a small circular aperture placed very close to the dorsal lamina. There is no peritubercular area.

Locality.—Tangier Bay, Strait of Gibraltar, August 5, 1870; depth, 35 fathoms.

[1] Named after Dr. Gwyn Jeffreys, F.R.S., who was in charge of the "Porcupine" during the first cruise of the expedition in 1870 when this species was obtained.

The single specimen for which this species is formed was dredged in Tangier Bay on the Coast of Morocco, during the cruise of H. M. S. "Porcupine" in the summer of 1870. It is a small colony of irregular shape attached by a narrow base, to which sand, &c., is adhering (Pl. IV. fig. 6).

From the massive form of the specimen and the considerable thickness of the test there can be no doubt that it belongs to the genus *Polycyclus*, and it differs in many respects from the last described species and from all other known species of *Polycyclus*. It is closely allied in some respects to *Polycyclus lamarcki*, and I was at first inclined to regard it as being merely a variety of that species, but a detailed examination revealed so many points of difference that I believe it is best to describe it as a distinct though closely allied species.

The general colour is pale yellow or yellowish-grey. The ends of the Ascidiozooids next the common cloacal apertures are each marked by a short brownish-purple streak, which, as it is traced towards the branchial aperture, dies away in the middle line but is continued a little further anteriorly at the edges. The body of the Ascidiozooid is rather more opaque than the surrounding test, but of much the same yellowish colour. The base of the colony, where test only is present, is of a darker but more transparent grey with opaque white dots thickly scattered over it.

The systems are not very numerous, and are not nearly so closely placed as in the last species. They are always distinctly separated from one another (Pl. IV. fig. 6). The systems are all nearly circular in form, and contain about six to eight Ascidiozooids each. The part of the Ascidiozooid seen on the surface is of elongated ovate form, with the narrower end pointing towards the centre of the system. The largest ones measure about 2·5 mm. in length and 1·5 mm. in greatest breadth.

Under a low power of the microscope the small branchial aperture, surrounded by a rather large opaque white sphincter, can be seen. The endostyle and the peripharyngeal band are also visible, and there are two opaque white spots placed one in the middle of each side between the sphincter and the peripharyngeal band. The nerve ganglion is also visible, and in many of the Ascidiozooids the anterior part of the branchial sac can be made out, the outlines of some of the stigmata and the upper ends of the six internal longitudinal bars being seen. In one or two cases the tentacles are also distinguishable. In this species, as in *Botrylloides purpureum*, a much greater amount of the internal anatomy is visible from the surface than is usually the case. This is due mainly to the great transparency of the superficial layer of the test and the absence of pigment in the mantle.

The common cloacal apertures can be readily seen with the naked eye in most of the systems. They are nearly circular, and have projecting membranous margins. Under a slight magnification this margin is seen to be lobed, one lobe usually corresponding

to each Ascidiozooid in the system. The edges of the lobes are somewhat variegated, as they contain irregular patches of white and brown pigment.

In a section of the colony it is seen that the Ascidiozooids occupy merely a thin surface layer 1·5 mm. to 2 mm. in thickness, while all the rest of the colony is made up of the soft gelatinous grey test, like the part exposed at the base of the colony, but more transparent. The superficial layer of test all over the colony is modified into a thin transparent but firm membrane; when this is removed the underlying test is found to be very much softer. The vessels of the test in this species are decidedly narrow (see Pl. IV. fig. 8, *v.*), and sometimes very fine vessels may be traced for a long distance. The terminal knobs are large, and are always more or less globular in shape. Although the matrix is as a general rule homogeneous, still in some parts a delicate fibrillation can be made out. The stellate test cells are usually very distinct.

The mantle at first sight seems to have no musculature, but under a high magnification (300 diameters and upwards) very delicate fibres are found in some parts of it. These are decidedly finer than in most of the Botryllidæ, and very much finer than those in the mantle of *Polycyclus lamarcki*. The connectives between the branchial sac and the mantle are very thin, and are sometimes of considerable length.

The branchial sac is wider than usual (see Pl. IV. fig. 7), and the meshes are considerably larger than in any of the other Botryllidæ in the collection; they are wider than long, and have usually five or six stigmata each (Pl. IV. fig. 9). The usual arrangement is as follows, going along the side of the sac from the dorsal lamina to the endostyle:—first a dorsal series of eight stigmata, then the first or dorsal internal longitudinal bar, then a mesh containing five stigmata, then the second bar, then a mesh with six stigmata and the third or ventral bar, then finally a ventral row of nine stigmata bounded by the endostyle.[1] The transverse vessels in some cases vary a little in size, but there is no regular arrangement; they have slight horizontal membranes attached to their inner edges; they have usually a few delicate muscle fibres.

The endostyle is broad (Pl. IV. figs. 7, 10, *en.*). The dorsal lamina is very distinctly ciliated along its free margin. Its narrow anterior end has a curious undulating course (Pl. IV. fig. 10, *d.l.*). There is a certain amount of irregularity in regard to the eight smaller tentacles. They are always very short (Pl. IV. fig. 10), but in some cases they are reduced to mere stumps, and some of them may be absent altogether. The prebranchial zone is pear-shaped (Pl. IV. fig. 10, *z.*), and has the narrower end ventral as in *Polycyclus lamarcki*. Two rounded masses of yellowish-green pigment are found at the sides of the prebranchial zone, one immediately posterior to each median lateral tentacle (Pl. IV. fig. 10, *pig.*). These are the two opaque spots seen in the surface view of the colony (see above, p. 67). Similar cellular masses are found in the same position in *Pyrosoma*.

[1] This may be expressed shortly by the following formula:—D.L.—8 sg.—I.—5 sg.—II.—6 sg.—III.—9 sg.—En.

The dorsal tubercle is placed very close to the anterior end of the dorsal lamina (Pl. IV. fig. 10, *d.t.*), and there is no proper peritubercular area. In some cases there is a slight bulging posteriorly of the peripharyngeal band at one side of the dorsal lamina, thus producing a slight enlargement of the prebranchial zone (Pl. IV. fig. 10), but this can scarcely be regarded as a true peritubercular area. The opaque yellowish-brown mass formed by the nerve ganglion and neural gland is clearly visible through the dorsal lamina (Pl. IV. fig. 10, *n.g.*).

The alimentary canal is rather small (Pl. IV. fig. 7.). The œsophagus runs posteriorly with a slight ventral curve. The stomach is ovate in form and decidedly small. It is deeply channelled externally, and has a short recurved cæcum springing from the anterior edge of its intestinal end. The intestine, which is narrower than usual in the Botryllidæ, runs ventrally for a short distance (Pl. IV. fig. 7) and then turns anteriorly and dorsally, and after running parallel with the stomach but not touching it, reaches the œsophagus, and then turns anteriorly again to become the short rectum which ends in an anus surrounded by a prominent lobed margin. The cloacal region of the peribranchial cavity into which the anus opens communicates with the common cloacal aperture of the system by a long atrial siphon formed of a prolongation of the mantle and provided with circular muscle bands which may be regarded as a diffuse atrial sphincter (Pl. IV. fig. 7, *at.*). This atrial siphon is sausage-shaped (Pl. IV. fig. 11), and has not the bulbous form found in *Polycyclus lamarcki*. It is lined in its entire extent by an invagination of the test, which at the base of the siphon expands in the peribranchial cavity into a disk-like membrane with lobed or crenated edges (Pl. IV. fig. 11, *t.*)

No ova were found in this species. The reproductive organs are placed in the usual position (see Pl. IV. fig. 7), and consist only of rather small irregularly lobed spermatic vesicles. It is rather remarkable that while ova were present along with the testes in such a closely allied species as *Polycyclus lamarcki*, they should be absent in all the Ascidiozooids examined of the present species. Only a very few buds or young Ascidiozooids were discovered. These have masses of young ova placed laterally in the usual positions, and have no testes. Hence the probability is that this is a protogynous species like others of the Botryllidæ.

Family II. Distomidæ.

Colony rounded and massive, rarely incrusting, either sessile or supported upon a long or short peduncle.

Systems irregular, inconspicuous, or absent.

Ascidiozooids of moderate length and having the body divided into two regions, thorax and abdomen; they may be provided with long vascular ectodermal appendages.

Test gelatinous or cartilaginous, often thickened at the base to form a peduncle, which may be traversed by large canals containing the vascular appendages of the Ascidiozooids.
Branchial Sac well developed; usually no internal longitudinal bars present.
Dorsal Lamina in the form of languets, rarely a plain membrane.
Alimentary Canal placed at the posterior end of the branchial sac.
Reproductive Organs in the intestinal loop, or alongside it.

I use this family name in a somewhat different sense to that in which it has been employed by previous writers. Giard considered that the family Distomidæ contained three genera—*Distoma*, *Diazona*, and *Sigillina*. The last named form I regard as one of the Polyclinidæ, and *Diazona* seems to be a connecting link between *Chondrostachys* and *Clavelina*, and is therefore extremely difficult to place. Perhaps the best way might be to leave it, as Della Valle placed it in 1877, in a distinct family by itself. This reduces Giard's Distomidæ to the genus *Distoma*. To this Della Valle added *Distaplia* in 1881, and in von Drasche's classification (1883) we find the family Distomidæ consisting of these two genera with the addition of a subgenus of *Distoma*, viz., *Cystodytes*. In a distinct but adjacent family, the Chondrostachyidæ, he places Macdonald's *Chondrostachys* and his own *Oxycorynia*, both interesting forms. So far as I can make out from von Drasche's definitions and descriptions, he distinguishes the two families upon the rather slender ground that in the Chondrostachyidæ the colony is supported upon a peduncle traversed by canals, while in the Distomidæ this is not the case, but the Ascidiozooids are provided with vascular ectodermal appendages. Now in the Challenger collection there are a considerable number of forms which are allied to *Distoma* and *Distaplia* in certain characters but they have peduncles, in some cases long and in others short, and these peduncles are traversed by canals, which, however, contain vascular appendages prolonged downwards from the posterior ends of the Ascidiozooids. Hence it is perfectly obvious that these forms, to which I have given the generic title *Colella*, unite the characters of the Chondrostachyidæ and the Distomidæ, and consequently render it impossible any longer to separate the two families. I have retained the older name, derived from what has all along been considered as the central form of this group, viz., *Distoma*, but the family has now much wider limits than it has had hitherto; and embraces at least the genera—*Chondrostachys*, Macdonald, *Oxycorynia*, von Drasche, *Colella*, Herdman, *Distoma*, Gaertner, *Cystodytes*, von Drasche, *Distaplia*, Della Valle, and, probably, *Symplegma*, Herdman. Whether or not *Diazona*, Savigny, should be added must be left doubtful.

The general form of the colony throughout the family is very variable, but usually it is of large size. Sometimes it is an irregularly rounded mass (as in *Distoma crystallina*), occasionally it is a more or less incrusting layer (as in *Cystodytes draschii*); while very

frequently it is a stalked club-shaped mass, the upper swollen part of which may be short and globular (as in *Colella gaimardi*), or long and cylindrical (as in *Colella thomsoni*). In some cases systems with common cloacal openings are formed, while in others the Ascidiozooids are not arranged regularly, and each one has an atrial aperture communicating separately with the exterior. In the latter case the atrial aperture is six-lobed, in the former it has a large atrial languet. The branchial aperture is always six-lobed. The test varies greatly in its condition. It may be only moderately thick and remain soft and gelatinous, or it may become greatly thickened, forming a peduncle or a very massive colony, and it may be very dense and cartilaginous, or may even develop calcareous spicules (as in the genus *Cystodytes*).

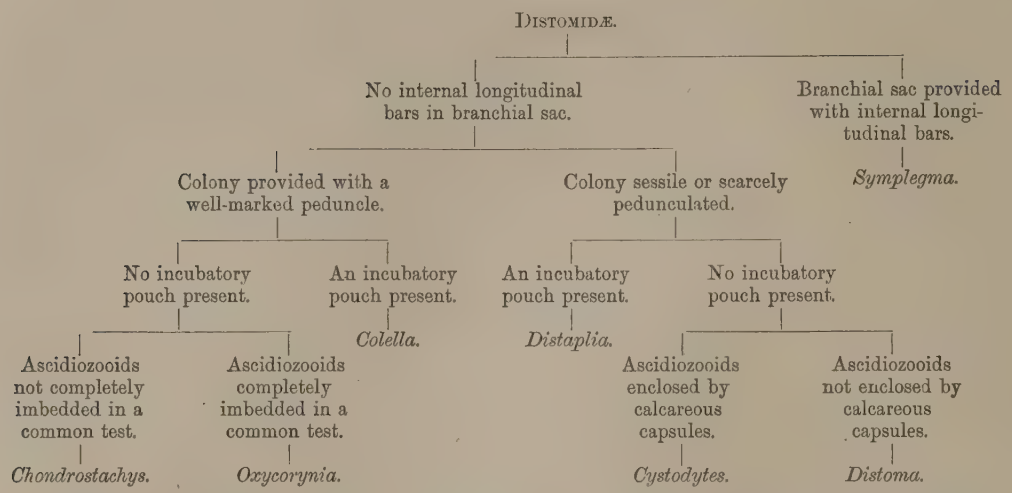
The Ascidiozooids are always of the *Distoma* type, and would have been considered by Milne-Edwards as "Didemniens." They have a thorax or branchial region, and an abdomen or intestinal region; usually the two are separated by a deep constriction (see Pl. XIV. fig. 5). There are generally vascular appendages or ectodermal processes, which, springing from the posterior ends of the Ascidiozooids, penetrate the test for considerable distances (Pl. V. fig. 13, and Pl. XIV. fig. 12, *v.ap.*), and may even branch to form networks like those met with in some Botryllidæ (see Pl. II. fig. 1, and Pl. XVIII. fig. 9).

The branchial sac varies greatly in size and number of stigmata. In *Distoma mucosa*, von Drasche, there are only three rows of stigmata, while in *Distoma adriaticum*, von Drasche, there may be as many as twenty-four. In some cases (*e.g.*, *Colella pedunculata*, Quoy and Gaimard) the stigmata may be very long and narrow, and more like those of some Simple Ascidians than of a Compound Ascidian. In *Symplegma* there are internal longitudinal bars, but in all other forms they are absent.

The alimentary canal also presents various conditions in the family. It may be short and thick, or it may form a long loop upon which the stomach is always a conspicuous organ. The wall of the stomach may be smooth or longitudinally folded or thickened irregularly.

There are usually a large number of spermatic vesicles, which all communicate by small ducts with a large vas deferens. The ova form a mass placed upon the intestinal loop and usually projecting beyond it. In some cases (*Distaplia* and *Colella*) the embryos undergo their development in a special prolongation of the peribranchial cavity, the incubatory pouch. The mature ova and the embryos are often of very great size (Pl. VII. figs. 7, 14, &c.). Gemmation takes place mainly, I believe, if not entirely, in connection with the vascular appendages. In some cases larval budding occurs.

The various genera in this family may be shortly distinguished by the following diagnostic characters :—



Of these seven genera, four are represented in the Challenger collections, viz., *Colella*, *Distaplia*, *Cystodytes*, and *Symplegma*.

Of the three remaining genera, *Chondrostachys* was described by Dr. J. Denis Macdonald in 1858 from a specimen found in Bass Strait, Australia; it has not, so far as I am aware, been rediscovered. It is a peculiarly interesting form, since it approaches *Diazona* and the Clavelinidæ in the partial independence of the Ascidiozooids. *Oxycorynia* was formed by Dr. R. von Drasche in 1882 for a species from the Caroline Islands. It is closely related to the new genus *Colella*. *Distoma*, finally, is the oldest and best known member of the family. It is distinguished superficially from the other genera by forming large massive generally sessile colonies.

Colella, n. gen.

Colony more or less club-shaped, and composed of a peduncle attached at the base and bearing on its summit a more or less ellipsoidal head.

Ascidiozooids imbedded in a common test, usually arranged in lines but not divided into systems. No common cloacal cavities visible. Body composed of thorax and abdomen and a long ectodermal process from the posterior end of the latter. Apertures six-lobed, not prominent.

Test gelatinous, penetrated by ectodermal prolongations from the Ascidiozooids.

Branchial Sac well developed; no internal longitudinal bars present.

Dorsal lamina composed of languets.

Alimentary Canal posterior to the branchial sac.

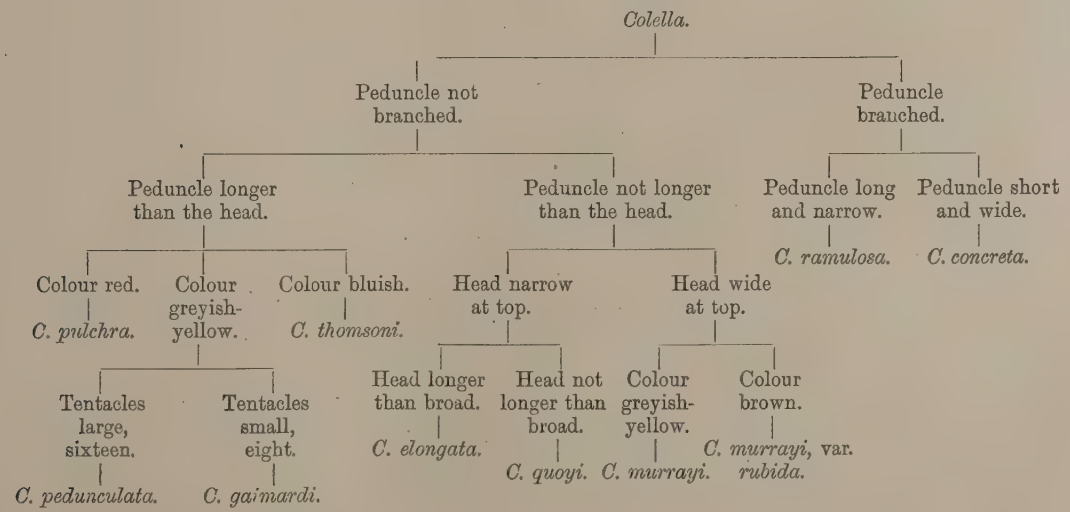
Reproductive organs placed on the left side of the intestinal loop. Testes grape-like in arrangement. Embryos develop in an incubatory pouch.

This genus is formed for a very striking and remarkable new species, *Colella thomsoni*, obtained near the Philippine Islands and some allied species from other parts of the world, but, as will be shown below, a species (*Colella pedunculata*) described fifty years ago by Quoy and Gaimard under the name of *Aplidium pedunculatum* also finds its place here. The two species, *Colella thomsoni* and *Colella pedunculata*, are very different in appearance, and at first sight seem to have nothing in common except that both are pedunculated Compound Ascidians. A careful examination, however, shows that they are really closely related.

The genus *Colella* is allied to *Oxycorynia*, von Drasche, and to *Distaplia*, Della Valle, and unites certain of their characters, the result being that it cannot be included in either of the older genera. Two courses are open, the first to unite the three groups under the generic title first published, *Distaplia*, 1881; the second to consider them as three distinct genera. I think there is sufficient difference between them to justify me in taking the latter course, but *Oxycorynia* and *Distaplia* can no longer be placed in distinct families as arranged by von Drasche, consequently I have, as is explained above, merged the Chondrostachyidæ in the older family, the Distomidæ.

Of the ten species of *Colella*, two (*Colella pedunculata* and *Colella thomsoni*) are described in detail. They are good species to take for this purpose, first on account of their central position amongst Compound Ascidians, and second on account of the fairly large size of the Ascidiozooids, especially in the case of *Colella thomsoni*.

The species of this genus may be distinguished by the following characters:—



Colella pedunculata (Quoy and Gaimard) (Pls. V.–IX.).

Aplidium pedunculatum, Quoy and Gaimard, Voyage de l'Astrolabe (Zoologie), t. iii. pt. 2, p. 626, pl. xcii. figs. 18, 19.

Aplidium pedunculatum, Cunningham, Voyage of the "Nassau," Trans. Linn. Soc. Lond., vol. xxvii. p. 490.

The Colony is club-shaped, and is attached by the base of a long peduncle, which increases in size as it is traced upwards to the ellipsoidal head in which the Ascidiozooids are placed. The surface is fairly smooth. The colour of the head is yellowish-grey; of the stalk yellow or brown.

Size—head, 1·5 to 3·8 cm. in length, 0·8 to 2·2 cm. in greatest breadth; stalk, 6·5 to 9·2 cm. in length.

The Ascidiozooids are imbedded in the common test, and are of fair size. The body of each is composed of thorax and abdomen with a long vascular appendage.

The Test is soft and gelatinous in the head, but hard and stiff in the peduncle.

The Mantle is rather thin, and the musculature is irregular.

The Branchial Sac is large, and has five rows of stigmata on each side. The transverse vessels are all of the same size. The stigmata are very long and narrow, and are regularly arranged.

The Dorsal Lamina is represented by a series of long triangular languets.

The Tentacles are sixteen in number and are all of the same size.

The Dorsal Tubercle has a simple circular aperture.

The Alimentary Canal is large, and extends for a considerable distance behind the branchial sac.

The Reproductive Organs are not of large size. They lie alongside the alimentary canal.

The Incubatory Pouch is very large, and may be coiled spirally.

Localities.—(*a*) Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8 F.

(*b*) Kerguelen Island, depth, 10 to 60 fathoms.

(*c*) Station 151, February 7, 1874; lat. 52° 59′ 30″ S., long. 73° 33′ 30″ E.; depth, 75 fathoms; bottom, volcanic mud.

(*d*) Station 315, January 26, 1876; lat. 51° 40′ S., long. 57° 50′ W.; depth, 12 fathoms; bottom, sand and gravel.

(*e*) Station 314, January 21, 1876; lat. 51° 35′ S., long. 65° 39′ W.; depth, 70 fathoms; bottom, sand; bottom temperature, 46° F.

Fifty years ago Quoy and Gaimard[1] described a Compound Ascidian under the name of *Aplidium pedunculatum*. A short description and two coloured figures were given. The latter show a single specimen of the natural size (*loc. cit.*, fig. 18) and a magnified view of a small portion of the surface (*loc. cit.*, fig. 19). The colony exhibits a striking

[1] Voyage de l'Astrolabe (Zoologie), 1834, t. iii. pt. 2, p. 626, pl. xcii. figs. 18, 19.

resemblance in shape and general appearance to the Challenger specimens, but differs from them in several details. While comparing the two it will be convenient to regard the colony as composed of two parts: the "head" or the terminal enlarged part in which the Ascidiozooids are imbedded, and the "stalk" or elongated peduncle, which bears the head at its upper extremity. The lower end of the stalk is attached to some foreign body.

The general shape of the head and its size relatively to the stalk are the same in the figure and in the Challenger specimens, the only point in which they are not absolutely identical being that in the "Astrolabe" specimen the head evidently did not contract quite so much at its lower end as is the case in those from the Challenger; this, however, is unimportant, as in some specimens it is easy to distort the shape of the head by allowing it to lie in an abnormal position.

The colour of the head in the figure is bluish-grey, while that of the Challenger specimens is more of a yellowish-grey.

In the figure the Ascidiozooids are arranged in vertical lines which run distinctly in pairs; further, the Ascidiozooids in a pair of lines are placed alternately so that each has, as its neighbours above and below, Ascidiozooids belonging, not to its own vertical line, but to the adjacent one. The result of this arrangement is that besides vertical lines the Ascidiozooids form spirals more or less perfect, especially in the middle part of the head.

In the Challenger specimens this arrangement, though probably present, is not nearly so well marked (see Pl. V. figs. 1, 2, 3). The pairing off of the lines can be made out in some heads or in parts of them, but in many places is not at all distinct, and in all cases the Ascidiozooids seem to be closer together. Much the same may be said as to the alternate position of the Ascidiozooids in the lines; in some places it is evident (Pl. V. fig. 3), in others it is not very distinctly seen (Pl. V. fig. 2). Still the spiral lines are visible here and there. On the whole, the arrangement of the Ascidiozooids in the Challenger specimens seems to be more irregular than in the figure of the "Astrolabe" specimens, though following the same plan.

In shape the stalks are identical in both forms. In colour, however, they differ. In the figure the upper third is light indigo-blue, of a darker shade than the head, and the lower two-thirds are yellow. In the Challenger specimens the colour varies from pale yellow to light reddish-brown, but in none is any part blue; in some, however, at the point of junction with the head, there is a collar of a darker shade of yellow or brown.

In the other figure (*loc. cit.*, pl. xcii. fig. 19) three apertures are represented and seem to be intended for a branchial and two atrials. Both kinds are distinctly six-lobed. In the Challenger specimens it is exceedingly difficult to make out the condition of the apertures, on account of their contracted state; they are, however, six-lobed, but not nearly so distinctly so as in the figure. Turning now to the short description in the text, it is found to give less information than the figures did. Quoy and Gaimard's specific diagnosis is as follows:—"Aplidium, ovatum, griseo-violaceum, longe pediculatum;

osculis numerosissimis, luteis, lineatis." Then follows a short paragraph of remarks containing nothing of importance. The specimens were found at King George's Sound and Port Western in the south of Australia.

On the whole there can be little doubt that this is our species. The differences in shape and arrangement of the Ascidiozooids are slight, and it has been seen that there is a certain amount of variation in these particulars among the Challenger specimens themselves. The appearance of blue in the "Astrolabe" specimen is more puzzling, but is not, I think, sufficient to separate the two forms. In ours the shades of grey, yellow, and brown vary considerably, and the "Astrolabe" one may have been abnormally coloured. It must also be remembered that the Challenger specimens have been in spirit for some years. The figure showing the lobed apertures with such wonderful distinctness and regularity may perhaps have been taken from the living animal, certainly nothing so perfectly regular is visible in the apertures of the Challenger specimens.

The only other reference to this species I can find is in the report on the animals obtained during the cruise of the "Nassau."[1] Professor R. O. Cunningham there reports from the Strait of Magellan, "*Aplidium pedunculatum*, Quoy and Gaimard, attached to *Macrocystis*."

During the Challenger Expedition this species was taken at six localities, viz., (1) at Station 313, at the eastern end of the Strait of Magellan, from a depth of 55 fathoms (five specimens); (2) at Kerguelen Island, 20 to 60 fathoms (one specimen); (3) at Kerguelen Island, 10 to 60 fathoms (three specimens); (4) at Station 151, south-west of Heard Island, 75 fathoms (1 specimen); (5) at Station 315, on the east coast of the Falkland Islands, 12 fathoms (1 specimen); and (6) at Station 314, between the Strait of Magellan and the Falkland Islands (2 specimens).

An examination of the external features alone of this form suffices to show that it does not belong to the genus *Aplidium*, as stated by Quoy and Gaimard and later by Cunningham, or even to the family Polyclinidæ; while the dissecting out of one of the Ascidiozooids from the common test shows that it is a member of the Distomidæ, but differs somewhat from the recognised genera. It is found, however, to agree in all essential particulars with the new and remarkable species *Colella thomsoni* and the other members of the same genus, to be described further on, and consequently the present species must be placed in the new genus *Colella*. Quoy and Gaimard's specific name *pedunculatum* is retained. It must be remembered, however, that the name was given when the species was supposed to be an *Aplidium*, and that the possession of a peduncle is a character common to all the species of *Colella*. As the animal had never been properly examined, I have submitted it to a detailed investigation, and, as it has some interesting peculiarities, an account is inserted here of the anatomy and histology for comparison with the detailed description of *Colella thomsoni* which will follow (p. 94).

[1] *Trans. Linn. Soc. Lond.*, vol. xxvii. p. 490.

Anatomy.

The colony is somewhat club-shaped (Pl. V. fig. 1), and may, for convenience of description, be divided into the stalk and the head. The stalk is attached by its lower extremity to some foreign body, and bears the head on its upper end. It is long and rather slender. It tapers downwards from the point of junction with the head to within a short distance of the lower end, where it spreads out to form a base of attachment (Pl. V. figs. 4, 5). It is generally undulating in its course, sometimes twisted spirally, marked with faint longitudinal striæ, and often wrinkled transversely (Pl. V. fig. 1); in one or two specimens it is slightly constricted just below the head, thus forming a sort of neck. In colour it varies from light yellow (straw colour) to light reddish-brown. In a few specimens there is a collar or darker band of brown just below the head. Opaque yellow dots of varying sizes up to 0·5 mm. may be seen, especially if the stalk be held up to the light, in the interior. They are largest and most numerous at the upper end (see Pl. V. fig. 10).

The head is roughly ellipsoidal in form; sometimes it is more of an oval, the pointed end being downwards. The investing mass between the Ascidiozooids is of a dull grey colour. There is always a patch of this to be seen, free from Ascidiozooids, at the summit of the colony. The Ascidiozooids appear externally as pale yellow blotches arranged in vertical lines. They are largest at the summit of the colony round the terminal bare patch, and gradually decrease in size as they are traced downwards to near the lower end. Here they rapidly get smaller, closer together, and less distinct till finally they are lost to sight at the top of the stalk. In some Ascidiozooids nothing more than the outline is visible, but in many a minute bright yellow opaque-looking dot is seen near the centre of the anterior extremity (Pl. V. fig. 2).

The head is essentially a mass of grey test, in the outer layer of which the Ascidiozooids are imbedded. Its inner part is traversed by the vascular appendages, which run inwards and downwards from the posterior or inner extremities of the Ascidiozooids. At the summit of the colony there are, as mentioned above, no Ascidiozooids, and of course no appendages, therefore in a transverse section of this region nothing but the grey test is seen. Here, however, it has generally a somewhat spongy, and, on the surface, ragged appearance (Pl. V. fig. 2).

In a section through the colony about the level of the top row of Ascidiozooids (Pl. V. fig. 7) an irregular disk of grey test is seen, having a few Ascidiozooids and masses of embryos lying in its periphery, and extending in nearly to the centre.

A transverse section about the middle of the colony (Pl. V. fig. 8) shows the same disposition of Ascidiozooids and of embryos in various stages of development, but here they only occupy the outer half of the disk, leaving in the centre a circular piece of grey substance which is more or less spongy as it is traversed by canals containing the

appendages of the Ascidiozooids above. These are at first few in number, and are chiefly in the central part, but as they descend through the colony their number increases till at the base of the head they are found throughout the whole extent of the central mass of test (Pl. V. fig. 9 and Pl. VIII. fig. 11).

The canals containing the vascular appendages are continued down into the stalk. At the upper end they are very numerous (Pl. VIII. fig. 10), but as they descend they gradually decrease in number, till at the base of attachment a section shows nothing but the test substance.

The masses of embryos referred to as seen in sections of the head appear in the form of spirally coiled sacs lying one alongside each Ascidiozooid, and attached to it by a narrow pedicle (Pl. V. fig. 13).

In sections of the stalk the yellow bodies mentioned above as being visible externally are seen imbedded in the ground tissue (Pl. VIII. figs. 1–9). They are largest and most numerous near the upper end of the stalk. They will be minutely described further on (page 90).

The outer layer of the stalk is seen in sections to form a kind of cuticle, to the surface of which sand, &c., is sometimes attached, and which is of a firmer nature than the spongy central part. To this cuticle is due the yellow or brown colour of the stem, the inner part being of a grey colour.

Histology.

Investing Mass or Test.—This is the grey substance or ground mass out of which the greater part of the colony is formed, and it is homologous with the "test" of the Simple Ascidian. Its structure is well seen in a section of the bare patch at the top of the colony (Pl. V. figs. 14, 15). It consists of a hyaline homogeneous matrix in which cells are imbedded. These are of two kinds, of which one is very remarkable. They are very large (0·04 to 0·08 mm.); oval, spherical, ellipsoidal, or polygonal in shape; hollow inside, and suggest at once the name "bladder cells," having in fact only a thin layer of protoplasm lining the inner wall, against which the nucleus lies. The nuclei are very distinct (the largest being about 0·008 mm. in length), they are round, oval, or fusiform in shape, stain readily with carmine, and are always situated close to the inner wall of the cell. There is often a little mass of protoplasm at the point where the nucleus lies. The outlines of these cells are very delicate, but distinct and beautifully regular (Pl. V. fig. 15). They are very numerous, forming by far the greater part of the tissue. Even in the places where they are least numerous they encroach so much on the matrix as to reduce it to a strongish network between the bladder cells. In other parts the matrix exists only in the form of delicate threads and membranes surrounding the large vesicles, while in some places the latter have increased to such an extent that no matrix

is visible, and the bladder cells have become polygonal by mutual pressure (Pl. V. fig. 17). The second form of cell is found wherever a small patch of matrix can be seen. They are the test cells, and are small (0·008 to 0·01 mm.), ellipsoidal, fusiform, or stellate in shape, and consist of a large nucleus surrounded by a little protoplasm which sometimes stretches out to form long delicate processes. These cells stain deeply with carmine.

Under a low power (50 diameters) this test tissue looks like a fine network minutely dotted over (Pl. V. fig. 14). The meshes are formed by the bladder cells, of which several layers may be in focus at once, and the dots represent the nuclei of both kinds of cells. When magnified 200 diameters the structure is apparent (Pl. V. fig. 15). The outlines of the large bladder cells seem to cut each other constantly; this is due to the fact that more than one layer is visible. If care be taken to focus three or four cells lying in the same plane, it will be seen that they never intersect or open into one another, and that except when they are very crowded a thin layer of matrix lies between them. In some places under this power the tissue looks as if composed of large protoplasts (the patches of hyaline matrix, containing the small fusiform cells with large nuclei) united to one another by radiating processes and leaving large lacunæ between (the bladder cells). This appearance is very striking in some preparations stained with picrocarmine (Pl. V. fig. 17).

A higher power (350 diameters) shows better the nuclei of the bladder cells and their parietal position. Coarse granules are generally visible in these nuclei. Throughout the rest of the head the investing mass has essentially the above described structure; the bladder cells, however, are generally not quite so large, and are much more crowded, being polygonal in shape; sometimes they form regular hexagons, showing no matrix except here and there at the angles. The central part of the head, as mentioned above, is quite spongy in appearance, being channelled out by the vascular appendages. Under a low power (50 diameters) a section of this region presents a curious appearance (Pl. V. fig. 16). The large spaces (about 0·2 mm. across) reduce the tissue to an irregular reticulum, the thick bars of which have the ordinary structure of bladder cells, &c., while here and there are seen threads too narrow to contain a bladder cell; these are formed of the matrix, with its small spindle-shaped test cells.

Towards the base of the colony, on account of the greater number of vascular appendages which have to be accommodated, the spongy area is greater in extent and the amount of tissue in the spongy part is less, being reduced to bars of nearly uniform thickness which enclose spaces of hexagonal form, thus making a regular network (Pl. VIII. fig. 11).

Over the whole head the surface layer of the test tissue differs slightly in structure from the central part (Pl. V. fig. 17). It contains no bladder cells, but is formed merely of the homogeneous matrix and the small fusiform or stellate test cells. This layer can be stripped off as a delicate membrane from the surface of the tissue beneath. The

layer of test which immediately surrounds each Ascidiozooid is also of the same nature, being destitute of bladder cells.

The peduncle is composed chiefly of the same tissue which forms the test or investing mass in the head. The external layer, however, is somewhat modified (Pl. VIII. figs. 6–8); it is very compact, contains no bladder cells, shows an indication of fibrillation, and is of a yellow or yellowish-brown tint. To its external surface grains of sand are sometimes found adhering. This external cuticle passes gradually into the normal tissue of the stalk (Pl. VIII. fig. 8), which shows a homogeneous matrix containing bladder cells, generally isolated, and never so numerous as is the rule in the head, and many of the ordinary small fusiform and stellate cells; these are arranged in the outer part so as to form rows more or less parallel to the outer edge of the section.

At the very base of the colony the tissue is compact, but a short distance up (Pl. VIII. figs. 2, 6) a few tubes channelled through it and placed at first in the centre of the section are met with. Further up these increase in number and encroach more on the peripheral layers, till, near the top of the stalk, they are found scattered over the whole section except in a narrow zone just under the cuticle. These canals contain the downward prolongations of the vascular appendages already mentioned as being continued through the test from the posterior extremities of the Ascidiozooids. The vascular appendage occupying a canal appears as a thin-walled tube of varying width, divided longitudinally into two cavities by a delicate septum, so that in reality the vascular appendage is formed of two vessels running side by side (see Pl. VIII. figs. 10, 11, 12, *v. ap.*).

In sections of the stalk the small yellow dots which were visible externally are frequently met with. These are now seen to be gemmæ or buds in various stages of development (Pl. VIII. figs. 6, 7, 8, 9, *emb.*). They begin to appear a short distance above the base of the stalk, increase in number (for a certain time), and advance in development as they are traced upwards.

Mantle or Muscular Coat.—This layer forms the true body-wall of the Ascidiozooid. It covers all the other organs of the body, and lies directly under the investing test, with which, however, it is throughout the greater part of its extent not closely connected. A cavity, in spirit specimens at least, in which the Ascidiozooid lies is distinctly visible. The mantle is united to the test at the apertures, and is in close contact with it on the vascular appendage and the incubatory pouch. In the living animal, however, when the muscles were relaxed and the peribranchial space filled with water, the mantle was doubtless in contact with the test throughout, and there was therefore no cavity around the Ascidiozooid.

The mantle is a delicate sac with two openings, and having rather an elaborate shape, covering as it does all the organs and appendages of the body. Its form therefore is the same as that of an Ascidiozooid dissected out from the test, which will now be described.

The Ascidiozooid (Pl. V. fig. 13) may be divided into the body, the vascular appendage (*v. ap*), and the incubatory pouch (*n. p.*). The body, like that of all the Distomidæ, consists of two regions, the thorax and the abdomen. Of these the thorax is rather the larger, and is the more anterior or superficial of the two. It is flattened laterally and is rudely quadrangular in shape, the ends being anterior and posterior, the margins dorsal and ventral, and the sides right and left. It has the branchial and atrial apertures at its anterior extremity, is united to the abdomen posteriorly by a narrow neck, and has the incubatory pouch as a large diverticulum on its dorsal edge. The thorax consists of the branchial and atrial siphons, the branchial sac with all its contained organs, the tentacles, the nerve-ganglion and the neural gland, the upper part of the œsophagus, the terminal parts of the rectum and genital duct, and the atrium or peribranchial space—the whole being surrounded by the mantle.

The abdomen lies posterior to or deeper than the thorax, to which it is united by a narrow neck formed of the œsophagus, the rectum, the genital duct, and a covering of mantle. The abdomen is smaller than the thorax, is of an oval or ellipsoidal shape, and has the long vascular appendage attached to its posterior extremity. It contains the remaining organs of the body, namely, the stomach and intestine, the genital glands, and the heart.

The vascular appendage starts from the posterior end of the abdomen on the right side, and runs, as will be more minutely described hereafter, inwards and then downwards through the colony.

The incubatory pouch is a large spirally coiled diverticulum from the peribranchial space, with the dorsal part of which it communicates by a narrow duct.

The mantle forms the outer wall of this irregularly shaped body, the parts of which have just been enumerated. It does not vary much in thickness; the part covering the abdomen, however, is thinner than that on the thorax, which, excluding the siphons, is nearly equally strong all over; the neck of the incubatory pouch is thicker than the rest of that sac, the farther end being rather weak. The parts forming the two siphons are the strongest of all (Pl. VI. fig. 2), and the marginal lobes of the branchial aperture especially predominate (Pl. VI. fig. 4, *br.*).

Histologically the mantle is composed mainly of three elements—the connective tissue, the muscles, and the epithelium. The connective tissue is the ground-work, and is present in the form of a thin hyaline homogeneous membrane, containing many scattered cells; it encloses and joins the bundles of muscle fibres, and is clothed on its inner surface by a layer of tessellated epithelium. The connective tissue cells are round, fusiform, and stellate in form, have granular protoplasm, and generally distinct nuclei which stain readily with carmine. In some parts of the mantle, as, for example, on the thin part of the incubatory pouch, many stellate cells are present, and the long processes of adjacent cells unite, forming an intricate network. On the narrow neck of the incu-

batory pouch the cells are fusiform, and are arranged with their long axes placed along the length of the neck. They are very close together, and form a nearly compact tissue of longitudinally placed rows of cells. These fusiform cells have their ends in many cases greatly drawn out so as to resemble fibres. Cells of the normal spindle-shape without the terminal fibres occur also on the lobes at the margins of the apertures. Here also, as on the neck of the pouch, they form a rather compact layer.

The muscle fibres are non-striped, very long, almost colourless, stain yellow with picrocarmine, and exhibit no traces of a nuclei. The different parts of the mantle vary greatly in the amount and disposition of the musculature. In the thin part covering the abdomen, and adhering closely to the subjacent organs, muscular fibres are usually not visible at all, though occasionally in the upper part, next the thorax, a few delicate stragglers may be seen. The thorax, on the other hand, has fibres running in almost every direction. They are arranged in bands, generally two or three fibres thick, which branch and unite again (Pl. VI. fig. 5); single fibres being alone for short distances only, as when they stretch from one band to an adjacent one. A number of bands are more or less transversely placed, encircling the middle and lower part of the thorax as a series of equidistant parallels (Pl. VI. fig. 4); often, however, they are more irregular. This is the rule on the anterior part of the thorax where the bundles cross at all angles and seem at first to have no definite arrangement. On account of the anterior curvature the circular bands, as they pass over the dorsal and ventral margins, are directed posteriorly, this gives them an oblique course and causes a decussation of those from the two margins (Pl. VI. fig. 4). A few longitudinal fibres are also present running down the sides of the thorax from the sphincter muscles of the apertures. These cross the densest part of the decussation of the circular fibres, which is in the middle of each side just posterior to the branchial aperture, and thus form a patch from which fibres seem to radiate in all directions. On each side, near the ventral margin, a long and rather close bundle of fibres may be seen running in a curved direction from the branchial siphon to the posterior end of the sac where the fibres diverge, many of them sweeping round to the dorsal edge.

The ventral margin over the endostyle (Pl. VI. fig. 4) seems to be more muscular than the corresponding region of the dorsal edge, the bands also cross, branch, and anastomose more frequently; possibly this may be accounted for by the more anterior position of the ventral margin, the atrial aperture being slightly posterior to the branchial. Circular muscle bands act as sphincters at the two apertures (Pl. VI. figs. 2, 3, 4). They are placed around each siphon and the fibres are much coarser and closer than on any other part of the thorax. The branchial sphincter is stronger than the atrial.

Over the incubatory pouch the musculature, though stronger than over the abdomen, is feebly developed. In the young pouch not a fibre is visible, but in those which

are fully developed delicate and rather distantly placed bands, occasionally forking, are to be seen. Near the neck in some pouches the bands become stronger and more numerous.

The epithelial elements of the mantle are represented by, (1) the ectoderm externally separating the test from the mantle and covering the latter in its entire extent. Over the incubatory pouch and in some other parts the ectoderm cells are provided with long, pointed, hook-like processes which extend outwards into the test, bolting the two tissues together (Pl. VI. figs. 7, 8); and (2) a single layer of tessellated epithelium is placed on the inner aspect and clothes the surface of the connective tissue. It is of extreme tenuity and delicacy, being only visible under the most favourable circumstances. Here and there, when looked for carefully, the outlines of small groups of cells may be distinguished in the unstained tissue; usually, however, nothing is to be seen. By using nitrate of silver or osmic acid the outlines are rendered much more distinct, and, in most cases, the nuclei are also displayed (Pl. VI. fig. 9). The cells are polygonal (four-, five-, and six-angled), form a continuous layer, and seem perfectly transparent. The nuclei are of moderate size, circular in outline, placed near the centre of the cell, and seem finely granular in texture. This layer of epithelium is the "parietal layer of the atrial membrane" of Huxley, the "lining membrane" of Hancock, or the "third tunic" of Milne-Edwards. It forms the bounding wall of the peribranchial cavity or atrium, and is directly continuous with the outer of the two membranes which enter into the formation of the wall of the branchial sac.

Branchial Sac.—This organ occupies the greater part of the thorax, almost entirely filling the peribranchial cavity. It is composed fundamentally of two delicate membranes, the outer being the visceral layer of Huxley's atrial membrane, and the inner the endoderm of the anterior portion of the alimentary canal. These during the course of development are approximated, through the enlargement of the pharynx, come into close contact at different points, and fuse together. These places gradually grow thinner, and finally become perforated, thus forming stigmata, while the tracts over which the membranes do not unite remain as hollow canals, the blood-vessels of the branchial sac.

The organ in this species is a flat sac shaped somewhat like the letter B (Pl. V. fig. 13), having an indentation near the middle of its ventral edge. Besides the stigmata, which communicate with the peribranchial space, it has two orifices, one at the anterior end, the branchial aperture or mouth, by which water and food enter the organism, and the other near the posterior end, the œsophageal aperture, by which food enters the alimentary canal.

The endostyle (Pl. V. fig. 13, *en.*) runs along the ventral, and the dorsal lamina along the dorsal edge of the branchial sac, while the circlet of tentacles, the dorsal tubercle, and the peripharyngeal band are situated at its anterior extremity. All these organs will be described further on.

The stigmata occur over the whole interior of the sac, from the peripharyngeal band

anteriorly to the base where the œsophagus opens posteriorly, with the exception of a narrow band along the dorsal and ventral edges, where the dorsal lamina and endostyle are placed. They are arranged in horizontal (transverse to the antero-posterior axis) rows, and are separated by transverse and longitudinal vessels (Pl. VI. fig. 10, *tr.* and *l.v.*). There are about five such rows and about twenty stigmata in each row in the adult animal. In shape they are elongated slits with parallel sides and rounded ends (Pl. VI. figs. 10, 11, 17).

The vessels or blood channels of the branchial sac are divided according to their direction into two groups, the transverse and the longitudinal. The transverse vessels are the largest. They run round the sac horizontally, forming arcs of circles springing at the two ends from the great dorsal and ventral thoracic trunks, which communicate more or less directly with the heart, and giving off anteriorly and posteriorly the slender longitudinal vessels which separate the stigmata. These longitudinal vessels forming the second group, besides being smaller in calibre, are much shorter than the transverse, and merely form short connecting ducts between these latter.

The walls of the longitudinal vessels show externally a single layer of flat cells like those on the inner surface of the mantle, but more easily made out (Pl. VI. figs. 12, 13). The cells are often rhomboidal or pentagonal in shape, and have large nuclei which are distinctly seen after staining with nitrate of silver. The walls of the larger transverse vessels show the same structure with the addition of a few muscle fibres running along their length. What seems from the interior or exterior of the sac a single row of ciliated epithelial cells surrounds each of the stigmata (Pl. VI. figs. 11, 12, 13), that is, rests on the outer wall of the longitudinal vessels, along the sides of the stigma, and for a very short distance on the transverse vessels at the two ends. When, however, a transverse section of one of the small longitudinal vessels (Pl. VI. fig. 15), or a view of the vessel from the stigma (Pl. VI. fig. 14) is obtained, it is seen that each apparent cell is in reality three or four narrow cells placed side by side so as to form a longitudinal band of ciliated epithelium extending down the side of the vessel. These ciliated cells vary somewhat in shape, being found in all intermediate degrees between barrel-shaped and mitriform or shortly conical (Pl. VI. figs. 12, 13); the free ciliated edge is always the more convex one. The most common form is nearly semicircular (Pl. VI. fig. 11), the flat face being next the vessel and the curved one next the stigma. These cells have strongly marked outlines, granular contents, and distinct nuclei placed rather below the middle (the non-ciliated side being the base). The nuclei vary in shape according to that of the cell. When the latter is barrel-shaped they are elongated (Pl. VI. fig. 12), while in the semicircular and conical forms they are circular in outline (Pl. VI. fig. 13). The cilia are long and delicate. There are from five to ten on each cell, attached to the more or less convex outer edge, and when fully extended they are about twice the height of the cells (Pl. VI. figs. 11, 12, 13).

The branchial sac is shown by its relations and development to be a pharynx greatly enlarged and modified to serve as a respiratory organ. The water, when the muscular mantle is relaxed, enters the sac by the branchial siphon and streams through the stigmata into the peribranchial space, bathing in its passage all the thin-walled vessels and aerating their contained blood. The current of water is directed by the lashing of the cilia bounding the stigmata. In nearly every specimen examined one or two small Copepod Crustaceans were found living in the branchial cavity as commensals.

Endostyle.—The endostyle runs along the ventral edge of the branchial sac (Pl. V. fig. 13 *en.*). It begins anteriorly at the base of the branchial siphon immediately behind the peripharyngeal band and runs backwards to the base of the sac, ending at the ventral edge of the œsophageal aperture. The ends are bluntly conical (Pl. VI. fig. 4), otherwise it is of the same breadth throughout. Its course is far from being a straight one. In its longitudinal and lateral plane (from side to side) it forms a series of minute undulations, which are sometimes especially marked in its anterior part (Pl. VI. fig. 3, *en.*), while in its longitudinal dorso-ventral plane (Pl. V. fig. 13) it describes two large curves of nearly equal size with the convexity outwards (ventrally) and separated by a deep depression; these form the B-shaped ventral edge of the branchial sac.

The endostyle is a groove with greatly thickened sides formed of columnar epithelium, while the base is covered with squamous epithelium. The summits of the edges are continued up as lip-like folds, which sometimes arch over so as to form what seems to be a canal. A tract along each side and the base are richly ciliated. Seen from the dorsal or ventral aspects, the endostyle shows a pair of thick brown semi-opaque bands separated by a more translucent area (Pl. VII. fig. 2). The opaque bands are caused by the thickened sides, separated by the less massive floor of the groove.

Dorsal Lamina.—This is probably the best designation for the very variously named organ which runs along the dorsal edge of the branchial sac opposite to the endostyle. It varies greatly in the details of its structure in different Ascidians, but two chief modifications are generally recognised—(1) where it occurs as a lamina or membrane, and (2) as a series of tongue-like processes or languets. These two conditions of the organ look very different, but are really merely the extreme modifications of intermediate stages which are also found. Beginning with the lamina or simple broad membrane, we find that this may be traversed by horizontal equidistant ribs or thickenings more or less strongly marked. The next stage is when these ribs, extending to the free edge of the membrane, form thereon, when seen in profile, a series of slight tubercles. These marginal tubercles are found in every degree of development, from the merest points up to large teeth and finally long conical languets. As a rule the breadth of the membrane seems to be in inverse ratio to the development of the marginal tubercles. In working through a series of dorsal laminæ, as the tubercles increase in size the membrane

between them becomes more and more crenated till finally a point is reached where the dorsal lamina exists no longer as a membrane but is replaced by a series of triangular or conical processes.

In the species under consideration the dorsal lamina is in an intermediate condition. A membranous band extends along the dorsal edge of the sac, from the peripharyngeal band to the œsophageal aperture, and from this a series of long thin pointed processes spring at nearly equal distances. Each process or languet is placed at the intersection with a transverse vessel, is about 0·1 mm. in length, is roughly triangular in outline (Pl. VII. fig. 3), and has somewhat undulating edges. A delicate membrane extends between the languets in a series of festoons, but does not reach quite to their points.

Tentacles.—The tentacles are placed in a circle round the base of the branchial siphon just at the entrance of the branchial sac. The branchial siphon is a short funnel formed by the mantle and having the thickened six-lobed margin already described. Its inner surface is lined by an invagination of the outer test, which is of extreme delicacy and transparency, and extends as far down as the tentacular circlet. This point therefore may really be considered as the mouth of the animal, the siphon being merely a depressed portion of the surface leading to the true oral aperture.

The tentacles (Pl. VII. figs. 2, 6) are simple, long, and rather stout, being large in proportion to the size of the animal. When directed upwards they project beyond the external opening of the branchial siphon. They are about sixteen in number, and are all nearly of the same length. They are attached by their bases to a strong muscular band which encircles the base of the branchial siphon, it has the lower end of the invaginated test attached to its upper edge, and is in relation with the prebranchial zone by its lower edge.

Each tentacle is attached separately and has a swollen base, a round tapering and generally curved stem, and a rather blunt apex. Along one side a strong band of cubical ciliated epithelium is placed (Pl. VII. fig. 4). The rest of the wall of the tentacle is formed externally of squamous epithelium (Pl. VII. fig. 4). In the interior, near the concave side, a dark line is seen running from the base nearly to the extremity. This is a septum formed of connective tissue and dividing the interior into two cavities just as in the tentacles of Simple Ascidians.

The Peripharyngeal Band is composed of a row of ciliated cells and encircles the top of the branchial sac (Pl. VI. fig. 3, *p.p.*). It is connected at its ventral and dorsal ends with the anterior extremities of the endostyle and dorsal lamina. In the bay formed where it curves posteriorly to meet the latter, the dorsal tubercle is placed (Pl. VII. fig. 6).

Anterior to the peripharyngeal band is a clear space extending nearly to the base of the tentacular circlet. This is the zona prebranchialis (Pl. VII. fig. 2). Its upper boundary is formed by a ciliated circle like the peripharyngeal band, and placed just

behind the tentacles. It has a remarkably undulating course (see Pl. VII. fig. 2), and is rather broader than the peripharyngeal band.

Dorsal Tubercle.—This organ (Pl. VII. fig. 6) is placed at the anterior end of the dorsal edge of the branchial sac, just in front of the end of the dorsal lamina, and in the bay formed by the bending posteriorly of the peripharyngeal band. It lies in the prebranchial zone, and is therefore anterior to the peripharyngeal band. On account of the blood sinus immediately superficial to it, which contains in this species a mass of very opaque white corpuscles (Pl. VI. fig. 3, *n.g.*), it is only in a few cases, and with great difficulty, that the dorsal tubercle can be made out at all. Its outline is oval or nearly round, and the aperture is simple (Pl. VII. fig. 6).

Nerve Ganglion.—The nerve ganglion (Pl. VII. fig. 5) is in its usual position on the dorsal side of the branchial aperture, nearer the branchial than the atrial aperture. It lies in the inner part of the mantle, and is covered by a large blood sinus (Pl. VI. fig. 3, *n.g.*), on account of which it is only visible from the inner aspect. It is elliptical or nearly circular in outline, the ends being a little pulled out where the nerve fibres run outwards towards the two apertures (Pl. VII. fig. 5).

The Alimentary Canal is contained partly in the thorax and partly in the abdomen. Excluding the branchial sac, it may be divided into three parts, the œsophagus, the stomach, and the intestine (Pl. V. fig. 13).

The œsophageal opening is placed at the posterior end of the branchial sac, nearer the dorsal than the ventral edge, but pointing towards the endostyle, from which it is separated by a slight elevation. A short wide œsophagus (Pl. VII. fig. 7) leads backwards and dorsally to the cardiac end of the large stomach. The wall of the œsophagus is lined by columnar epithelium, and is rather thin. Seen on the inner surface, the cells form an irregular minute mosaic; their nuclei are generally not visible.

The stomach (Pl. VII. fig. 7; and Pl. V. fig. 13, *st.*) is a large cavity of somewhat oval form, the anterior or cardiac end being the largest. Its outer (dorsal) edge is sometimes flattened or even depressed in the centre, but is usually gently convex. The internal (ventral) edge is always convex, and is shorter than the outer edge. The internal surface of the stomach is not raised into any folds or rugæ, such as are found in some other Compound Ascidians. The wall is thicker than that of the œsophagus, and is lined by columnar cells with shorter columnar, fusiform, or irregularly shaped smaller cells between and below them. As in the wall of the œsophagus, the inner ends of the cells present a mosaic-like appearance.

The intestine (Pl. VII. fig. 7) begins at the pyloric end of the stomach, runs downwards and inwards for a short distance, then turns upwards and runs nearly parallel with the œsophagus till it reaches the level of about the middle of the stomach, then it curves round to the dorsal side, crossing the upper end of the œsophagus; and finally, turning anteriorly, becomes the rectum, which courses along the dorsal edge of the left

side of the branchial sac in its lower half, and terminates by opening into the atrial cavity. The anus is inconspicuous, being furnished in the adult Ascidiozooid with no lips, lobes, or raised margins, such as are seen in many Compound Ascidians. In a young specimen observed, however, the rectum was provided at its termination with a thickened border. It is just possible that this difference may be due to the fact that in the latter case the rectum was empty, while in the adult Ascidiozooids it was always found distended with fæcal matter.

From the above course it follows that the alimentary canal first runs dorsally, then ventrally, then ventrally again, and finally dorsally, and therefore describes a curve of which the first half has the convexity dorsal, and the second half has the convexity ventral.

The wall of the intestine has much the same structure as that of the stomach. On its inner surface, however, an arrangement of large clear cells may be seen, placed generally in a single row, and forming a wide-meshed network. No distinct nuclei are visible, but in some granules are present. As no concretions are ever found in them they cannot represent the renal vesicles seen on the intestine of some Simple Ascidians. Probably they secrete a digestive fluid and correspond to the gland which has been described as occupying a similar position in many other Compound Ascidians (see p. 22).

Blood-Vascular System.—The heart lies on the right side of the abdomen, close to the inner (ventral) edge of the stomach. It is a delicate fusiform tube with undulating walls, and is enclosed in an outer also very delicate membrane, the pericardium, which can only be made out with difficulty. At its anterior end the heart gives off two large vessels which run upwards to the thorax alongside the intestine, and are soon lost to view. At the posterior end three vessels are given off from the heart. One runs upwards along the stomach, another along the intestine, and the third is continued backwards into the vascular appendage, which traverses the peduncle and plays an important part in the process of gemmation.

Reproductive Organs.—The ovary is placed on the left side of the abdomen (Pl. VII. fig. 7), and, in the young condition, is confined to the intestinal loop. When it has attained its adult size, however, it spreads far beyond, covering the intestine in its lower part and extending beyond it on the ventral side enclosed in a sac-like diverticulum of the mantle (Pl. VII. fig. 8). The ova are distinctly visible, and vary in size from about 0·02 mm. to 0·15 mm. in diameter; the larger ones exhibit the germinal vesicle and germinal spot. The smallest ova observed are collected together to form a mass which lies generally at the base of the ovary (Pl. VII. figs. 9, 10). These young ova are irregular in shape, and are often triangular from mutual pressure. They have distinct strongly refracting nuclei resembling the germinal spots of larger ova, and the surrounding protoplasm stains very deeply with carmine. The mature ovum (Pl. VII. fig. 11) is spherical and of a yellowish-brown colour. It has a large germinal vesicle and a

strongly refracting germinal spot, both circular in outline. The vitellus is coarsely granular. Externally the whole is enveloped in a cellular coating, the follicle, which is composed of rounded or nearly quadrangular nucleated cells. When seen from the surface they are hexagonal or diamond-shaped in outline. A very delicately walled tube, which may be the oviduct, seems to run upwards to the atrium alongside the intestine, and to terminate close to the anus; on the other hand it may possibly be merely a fold of the mantle (see Pl. VII. fig. 7).

Among the smaller ova there may be seen some still smaller triangular or pear-shaped masses of protoplasm with no nuclei, but coarsely granular in texture, which stain strongly with carmine (Pl. VII. fig. 9). It is possible that these may be small spermatic vesicles, and such I believe them to be. If, however, they be merely young ova, then no trace of a testis has been discovered. Probably dichogamy exists here as in some other Compound Ascidians, and the colonies investigated were in their first sexual condition (protogynous), the testes being still in a rudimentary state.

Incubatory Pouch.—This curious organ (Pl. VII. figs. 7 and 12–14) is an appendage to the mantle, in connection with which the structure of its walls have already been described. It is merely an enormous diverticulum of the peribranchial or atrial cavity, in which the embryos lie during their development. It joins the atrium on its dorsal edge (Pl. VII. fig. 7) close to the anus and the termination of the oviduct (?). It has a very narrow neck, barely wide enough to let a mature ovum pass in, and far too small to allow any of the embryos found in the pouch to go back again to the atrium. The problem then is, how do the fully developed larvæ escape? Two methods suggest themselves as possible:—Either (1) they burst their way through the outer wall of the colony, which is not very thick, when the larvæ are fully developed and the incubatory pouch distended to its utmost, or (2) the entire pouch with its contained larvæ remains intact till in the natural course of events, as will be seen shortly (p. 93), it reaches the summit of the colony and is cast off. The larvæ may then be set at liberty by bursting the wall of the pouch or by its decay.

Another curious point in regard to the incubatory pouch is that the embryos at its far end are always the youngest, while those near the neck are generally completely formed tailed larvæ. Now if the ova, as they passed up into the peribranchial cavity, were deposited successively in the pouch, those at the far end would be the most advanced in development, and mature ova or very young embryos only would be found at the neck of the pouch. Thus the observed arrangement is the reverse of what would be naturally expected.[1] If, however, the ova are fertilized successively as they reach the peribranchial cavity, and then remain there for some time—until, in fact, they

[1] The greater part of this account of the structure, &c., of *Colella* was written some years ago. Della Valle has since observed a similar condition of the incubatory pouch and its contained embryos and larvæ in the genus *Distaplia* (*Arch. ital. d. Biol.*, vol. i. p. 193).

have all passed up from the abdomen—and if the incubatory pouch is then formed in such a way that the ova which have been fertilized last pass in first, and so reach the far end of the pouch, then the observed arrangement would be brought about. But I have no reason to believe that this is the actual process, as no Ascidiozooids were found with the peribranchial cavity full of ova and embryos for the reception of which an incubatory pouch had not yet been formed.

The Process of Budding.—As this account is taken from the observation of some chance sections of buds occurring in a few preparations of sliced stems, many gaps of course exist, and many points remain undetermined on account of sections in the proper direction, and at the proper stage of development, not being obtainable. Further study with more abundant material will be required to unite the various links and supply all details.

It has been already seen that from the abdominal region of each Ascidiozooid in the colony a long appendage extends downwards towards the base of the peduncle, that this appendage consists of a blood sinus in direct communication with the posterior extremity of the heart, and of a covering derived from the mantle or body-wall, and that in the peduncle these appendages lie in tunnels bored through, and separated from each other by, the investing mass (Pl. VIII. fig. 9).

These vascular appendages, as might be expected from their nature, contain blood-corpuscles; in the preserved specimens, however, the corpuscles are never very abundant. Throughout the greater part of an appendage they are scattered singly and sparingly; here and there, however, at or below the middle of the stalk, clusters of them may be seen adhering to the walls of the tube. These clusters vary in size from two or three corpuscles up to a dozen or so; in the latter case it may be generally observed that the wall beside them bulges a little outwards, so that they occupy a slight recess (Pl. IX. fig. 2). Probably the corpuscles now begin to divide, at any rate their number increases rapidly, so as to form a more or less spherical cellular mass placed in a diverticulum of the appendage. This is the beginning of the formation of a bud. This mass of cells increases in size and becomes ellipsoidal or almond-shaped (Pl. IX. fig. 3). The cavity in which it lies also enlarges, works its way into the adjacent investing mass, and finally becomes entirely shut off from the tube of which it originally formed a part (see Pl. IX. figs. 4, 5).

Before this migration has taken place the cells of the bud have come to be arranged in two concentric layers (see Pl. IX. figs. 3, 4, 6). How this takes place I was unable to determine. Probably the outer layer is formed from the wall of the vascular appendage (which is covered by an extension of the ectoderm) and the inner by a rearrangement of the blood-corpuscles (usually regarded as mesoderm cells). Two layers, however, are produced, an outer or ectodermic and an inner or endodermic, the latter enclosing a cavity, the archenteron.

The next process revealed by the sections is the longitudinal division of the archenteron into three cavities by the formation of two laterally placed lines of constriction. These cut across the cavity and unite with the opposite wall, separating off two lateral thin-walled spaces from the central much stronger sac (Pl. IX. fig. 7; Pl. VIII. fig. 8).

While this division has been taking place, or possibly before the process began, the neural tube has been formed. Unfortunately none of the specimens throw any light on its origin. This I more especially regret, as from Kowalevsky's observations it appears that in *Didemnium styliferum* and *Amaroucium proliferum* the neural tube is derived from the dorsal wall of the central compartment or mesenteron, an origin which, on theoretical grounds, seems very improbable. It is first observed (in my transverse sections) as a small but thick-walled tube, lying close under the ectoderm in the dorsal region, formed of a single layer of wedge-shaped nucleated cells and having a very small lumen (Pl. VIII. fig. 8). I am inclined to believe (although I have no specimens which prove it) that the neural tube arises, as in the development of the Ascidian from the egg, by the formation of longitudinal dorsal ridges of ectoderm which grow up, arch over, and coalesce, thus forming an ectodermal canal which occupies the dorsal region of the perivisceral cavity (the space between the primitive ectoderm and endoderm, not the future peribranchial cavity).

In sections where the archenteron is completely divided into three cavities the neural canal is always seen. It afterwards increases in size and the lumen enlarges; it also separates farther from the ectoderm and takes up a position nearly equidistant from the two primitive layers, or in some cases nearer to the endoderm (Pl. IX. fig. 8, *n.t.*). The bud as a whole has now grown considerably, and the ectoderm has changed its appearance. The number of cells is much greater, and individually they are longer, having a distinctly columnar form and a yellowish colour.

The three cavities into which the archenteron was divided also continue to increase in size, especially the central one, which is destined to form the alimentary canal, and chiefly the branchial sac. The two lateral cavities are not nearly so large, and their walls are composed of smaller cells. They tend to apply themselves to the outer wall of the central cavity and to curve round its ventral and dorsal edges; eventually they unite at the latter and form the peribranchial cavity or atrium.

An important process may be seen taking place in the ventral region of the primitive branchial sac. Soon after the division of the archenteron, two longitudinal lateral ridges grow inwards along the ventral part of the central division, leaving a deep groove between them. This is the origin of the endostyle. At one time it occupies nearly the whole breadth of the ventral region of the future branchial sac (Pl. IX. fig. 8, *en.*), and the cells of which it is composed are considerably larger than those of the rest of the wall.

Two buds which were cut in longitudinal section show (Pl. IX. figs. 9, 10) a further stage of development, in which three points of interest are seen, viz., (1) the

first appearance of the reproductive organs in the form of a few primitive ova placed dorsally and posteriorly, behind the branchial sac. The mass is of rounded form, and contains several young ova. (2) The formation of the intestine as an outgrowth posteriorly from the large branchial sac (mesenteron). It has the form of a short slightly curved blind tube (Pl. IX. fig. 9, *i*). (3) The union of the two lateral peribranchial spaces dorsally to form the future cloaca (Pl. IX. fig. 10, *p.br.*) Figure 9 represents a stage rather more advanced than figure 10. It shows the rectum leading up to the peribranchial cavity.

After this stage a gap occurs. With the exception of one specimen showing a transverse section through a branchial sac (Pl. IX. fig. 11) in which two rows of stigmata are already formed on each side and in which the endostyle is seen in the form of a pair of parallel folds, there are no further specimens till a stage is reached so far advanced that it can hardly be called a bud. It is a young Ascidiozooid (Pl. IX. fig. 12) with all its organs and four rows of roundish stigmata already formed. Its body is obscurely divided into the two regions of the adult Ascidiozooid, and, from the posterior end of the abdomen, the vascular appendage has begun to bud out. The position and destiny of this young Ascidiozooid will be discussed presently.

The preceding outline of the process of gemmation shows several points of interest, the first of which is the important position occupied by the vascular system in the formation of buds. In this respect, however, the present species does not stand alone, but resembles the Clavelinidæ amongst Ascidiæ Simplices and *Didemnium styliferum* (Kowalevsky), *Sarcobotrylloides wyvillii* and some other forms in the Ascidiæ Compositæ. The division of the archenteron into three longitudinal cavities, the two lateral being destined to form by their union dorsally the peribranchial cavity of the adult, seems to be a phenomenon of very general occurrence in Ascidian buds, and was described long ago by Metschnikoff in *Botryllus* and by Kowalevsky in *Perophora*, *Didemnium*, and *Amaroucium*. No transverse division of the buds such as takes place in *Botryllus* (Metschnikoff and Krohn), *Didemnium* (Kowalevsky), and *Amaroucium* (Kowalevsky) is met with in the present species.

In this case, as in others (see p. 59), I believe that it is possible to trace back the structures which enter into the formation of the bud to the two primary germ layers of the body of the adult Ascidiozooid. The wall of the vascular appendage which probably forms the outer layer of the bud is continuous with the mantle, and is therefore covered by ectodermal cells. The blood-corpuscles which lie in the vascular appendage and form the inner layer of the young bud are mesodermal cells. Now it has been shown by Kowalevsky and by E. van Beneden that in various Ascidians the mesoblast in the embryo is derived from the hypoblast.[1] Consequently the mesoblast cells, which become

[1] See also Seeliger, Zur Entwickelungsgeschichte der Ascidien, *Sitzungsb. d. k. k. Akad. d. Wiss. Wien*, Bd. lxxxv. Heft iv. p. 364, 1882.

blood-corpuscles, may possibly be regarded as supplying the endodermal element to the bud.

The Formation of the Colony.—It has already been stated that buds advanced in development are only met with in the upper part of the stalk, while at the very top the buds are almost in the condition of young Ascidiozooids (such as Pl. IX. fig. 12). These last form a perfectly graduated series with the young Ascidiozooids placed at the base of the head, showing very plainly that the latter are derived from stalk buds. All the middle part of the head is occupied by adult Ascidiozooids in full vigour, no young ones being found amongst them. In the upper part, on the other hand, it is evident that the colony is in a state of decay, gaps being found, and Ascidiozooids in a semi-decomposed condition occurring here and there, while at the very summit of the colony all is dead, no Ascidiozooids are present, and the investing mass is ragged and evidently wasting away (Pl. V. fig. 2).

All this suggests that the following is the probable method of increase and maintenance of the colony. After having been once established, by the development of a tailed larva, it grows from the lower part of the future stalk where the test substance or investing mass alone is produced. As this gets pushed up by the formation of more below it the end of a vascular appendage from the single Ascidiozooid in the head above penetrates down into it and in course of time produces one or more buds. These become imbedded in the investing mass around the vascular appendage, and proceed to develop, occupying, as they advance in age and size, successively higher and higher positions in the young stalk on account of the constant growth at the base of the colony. In this way, when fully developed, they reach the top of the stalk ready to take their places as young Ascidiozooids at the base of the head.

In the fully developed colony the buds are produced near the centre of the stalk, while, when they reach the base of the head, they occupy the outer layer. This change in position is caused by their being pushed outwards as they advance towards the head by the new vascular appendages which are constantly growing downwards from the young Ascidiozooids above them and which occupy the centre of the stalk. Thus the buds are gradually forced into their peripheral position.

After entering the head the young Ascidiozooids continue to grow and soon reach maturity, sending down their vascular appendages through the stalk to form new buds, and producing also tailed larvæ from true ova fertilized by the spermatozoa of the older Ascidiozooids. Still they are constantly being pushed upwards, and finally, after having developed and lived through the entire length of the colony, they reach the summit as old Ascidiozooids, die, and drop off.

In this way it is obvious that the colony when once established may be maintained; while if, as must be the case at first, the production of buds is in excess of the death and decay at the summit, the colony will increase in size.

On the other hand, after a certain period the power of reproducing by gemmation will probably decrease, and, as a result, the colony will dwindle away and finally disappear, new ones being doubtless formed by the free swimming tailed larvæ which escape from the incubatory pouches of the adult Ascidiozooids.

Colella thomsoni, n. sp. (Pls. X.–XIII.).

The Colony is somewhat club-shaped, and is attached by the base of an irregular peduncle which does not increase in size as it is traced upwards. The head, in which the Ascidiozooids are placed, is of an elongated ellipsoidal shape. The surface is smooth. The colour of the head is bluish-violet, of the stalk white.

Size—head 0·9 to 6·5 cm. in length, and 0·7 to 3 cm. in greatest breadth; stalk 7·2 to 13 cm. in length, 8 mm. in average diameter.

The Ascidiozooids are of very large size and are imbedded in the common test. The body of each is composed of thorax and abdomen with a long vascular appendage.

The Test is soft and gelatinous in the head, and considerably harder in the peduncle.

The Mantle is thin, but is fairly muscular.

The Branchial Sac is large, and has many rows of stigmata on each side. The transverse vessels are all of the same size. The stigmata are long and narrow, and are arranged with regularity.

The Dorsal Lamina is represented by a series of long triangular languets.

The Tentacles are eight in number, and are all of the same size.

The Dorsal Tubercle has a simple circular aperture.

The Alimentary Canal is large, and extends for a considerable distance behind the branchial sac.

The Reproductive Organs are not large, and lie alongside the alimentary canal. The testes are well developed; they are arranged in a grape-like manner.

The Incubatory Pouch is small, and is not coiled spirally.

Locality.—Station 212, January 30, 1875; lat. 6° 54′ N., long. 122° 18′ E.; depth, 10 fathoms; bottom, sand.

About a dozen specimens of this remarkable species were obtained off the south coast of the Philippine Islands, in shallow water. It resembles somewhat in external appearance *Oxycorynia fascicularis*, von Drasche,[1] from the Caroline Islands, and a Compound Ascidian figured by Gould,[2] and named "*Nephtheis* (*?*)," from the Sulu Sea, but differs from both. Besides other points of distinction, *Oxycorynia fascicularis* has the Ascidiozooids projecting at their anterior ends, while in Gould's species the peduncle is branched and the colour is green.

[1] *Verhandl. d. k. k. zool.-bot. Gesellsch. Wien*, Jahrg. 1882, Bd. xxxii. p. 175.

[2] United States Exploring Expedition, 1856, Mollusca, pl. lii. fig. 621.

Anatomy.

The colony of this species (Pl. X. fig. 1) agrees with that of the last in being more or less club-shaped, but generally shows more resemblance to an elongated head of clover borne on a thickened stalk. The stalk (Pl. X. fig. 3) is of a dirty white colour, is thick, bent, and twisted, and has an irregular surface, generally grooved longitudinally. Compared with the last species it is short in proportion to the size of the head, and instead of tapering downwards rather increases in diameter as it approaches the base, which is a thickened bulb generally covered with adhering sand-grains, shells, zoophytes, &c. (Pl. X. fig. 1), showing that this end was attached or imbedded in the sea-bottom. On account of the curvature of the stalk, the comparatively large head hangs downwards, its apex probably having been close to the ground. The colour of the stalk is the same in all the specimens, and no structure is visible from the outside. The head (Pl. X. figs. 1, 2) is more elongated than in the last species, and is generally thickest a short way from the base; from this point it tapers to the rounded apex. The investing mass is almost perfectly transparent. The Ascidiozooids are seen as dull white elongated patches arranged in spiral lines (Pl. X. figs. 1, 8). They are largest at the upper end of the colony, where, though arranged more openly (Pl. X. fig. 2), they extend almost to the summit, there being little or no bare patch as in the last species. At the base of the head they are smaller and are placed closer together (Pl. X. figs. 3, 7), but the difference in size is usually not very striking.

Almost the entire thorax of each Ascidiozooid is seen (Pl. X. fig. 8), and the two apertures, the sinus over the ganglion, and the endostyle, are easily distinguishable. The Ascidiozooids are placed so that the thorax inclines upwards and outwards (Pl. X. fig. 6), and as the endostyle may be seen running along the outermost edge of the thorax it follows that the atrial aperture and therefore the dorsal side of the Ascidiozooid is next the summit of the colony. The space between the Ascidiozooids seen through the transparent investing mass is of a dull indigo colour: this gives the head its characteristic bluish tint.

As in the last species the Ascidiozooids are arranged round the periphery of the head, the centre of which is occupied by an investing mass traversed by the vascular appendages attached to the posterior ends of the Ascidiozooids. The investing mass of the central region has a hyaline appearance, but is not so transparent as the part occupying the peripheral zone.

The Ascidiozooids are much larger than those of the last species, and are placed more vertically in the colony, in consequence of which they overlap, the abdomen of one being covered by the thorax of the next below (Pl. X. figs. 6, 7). On account of the small size of the incubatory pouch in this species, the embryos do not form a naked eye feature, the whole extent of the sections being occupied by the Ascidiozooids and the investing mass.

In a transverse section of the head three zones may be distinguished (Pl. X. fig. 5). The external one is formed by the transparent outer part of the investing mass in which are imbedded the light grey thoracic regions of the Ascidiozooids. The next or middle zone is composed of the transversely cut abdominal regions of a couple of rows of Ascidiozooids with very little matrix around them. The third or central zone has matrix alone (Pl. X. fig. 5), it is rather opaque, and its texture is spongy on account of the vascular appendages which traverse it.

In a vertical section (Pl. X. fig. 7) the same three zones are recognised. The inclined position of the Ascidiozooids which causes the overlapping is well seen, and it is noticeable that the abdomen is usually more nearly vertically placed than the thorax, thus accounting for the fact that more cut ends of the former than of the latter are seen in a transverse section (Pl. X. fig. 5). In a vertical section (Pl. X. fig. 6) the diminution in the size of the Ascidiozooids as they approach the base is very evident, but nothing resembling buds is visible in the stalk below. At the very base of the head, however, and seen in a vertical section as a sort of incomplete cap or funnel-shaped collar surrounding the top of the stalk where it becomes continuous with the central part of the head, is a narrow zone of buds or very young Ascidiozooids lying internal and posterior to the lowest row of adults (Pl. X. fig. 7), and evidently destined shortly to reach the periphery and appear as young but fully developed Ascidiozooids.

Histology.

Investing Mass or Test.—The matrix of the head; it has been seen, presents itself apparently under two different forms; in the outer thoracic zone it is gelatinous, but solid, homogeneous and transparent, while in the centre of the colony it seems firmer, but is spongy and irregular, being sometimes reduced to a reticulum, and is more opaque, having usually a bluish hyaline appearance. These two parts are, however, identical in structure, the difference in their appearance being due to the presence of the vascular appendages in the inner region of the investing mass.

Comparatively little structure is visible in this test. No bladder cells are present in any part of the colony, and the other cell elements are comparatively few, the great mass of the tissue being homogeneous apparently structureless matrix. The usual fusiform and stellate, and many smaller, nearly circular, test cells are present (Pl. XI. fig. 1, *t.c.*), while here and there another form occurs which may be considered intermediate between the branched test cell and a bladder cell. These are larger than the stellate cells, and are more or less globular or ovate in form; they have a delicate outline from which a few faint hair-like processes radiate outwards like the branches of the stellate cells; the protoplasm does not fill the cell, and it is generally accumulated

at one end around the nucleus, leaving a larger or smaller clear space between it and the cell-wall at the other extremity.

The peduncle is mainly composed of investing mass, and is seen on section to be very spongy in texture (Pl. XIII. figs. 1–4). Large and rather irregular longitudinal canals traverse it in great numbers and throughout almost its entire thickness. These are united by a vast number of smaller vessels which run in horizontal or transverse planes and communicate freely with the larger vessels (Pl. XIII. fig. 2, *v.*). The latter contain the vascular appendages closely attached to their walls throughout, and giving off lateral branches which occupy the smaller canals. Thus a colonial system of blood-vessels is formed, the vascular systems of the different Ascidiozooids being placed in direct communication with one another through the vascular appendages and their lateral branches in the peduncle.

In a transverse section (Pl. XIII. fig. 1) the matrix is seen in the form of a series of islands surrounded by the small horizontal vessels, while here and there (Pl. XIII. fig. 3) the cut ends of the larger vertical vessels are seen. The investing mass, as in the upper part of the colony, contains no bladder cells, only the small spherical, fusiform, and branched test cells being present (Pl. XIII. fig. 4).

Mantle.—Under this head, as in the last species, the shape of an adult Ascidiozooid dissected out from the investing mass will be described first. The body may be divided into two parts, the thorax and the abdomen, the latter of which bears the long vascular appendage. The incubatory pouch in this species is so rudimentary as not to require consideration apart from the peribranchial cavity of which it is merely a portion. The thorax is flattened laterally and has an oblong shape (Pl. X. fig. 9), somewhat narrowing as it recedes from the wide obliquely truncated anterior end where the two apertures are placed. The abdomen is rather long and narrow, and is rounded posteriorly where the vascular appendage projects from it (Pl. X. figs. 9, 10). It is of a dark indigo-blue colour, and gives the deeper part of the colony in which it lies the well-marked characteristic tint. These regions of the body contain the same organs as in the last species.

The mantle covers the thorax, abdomen, and vascular appendage in the form of a delicate sac with two openings, the branchial and atrial siphons. In its structure and the distribution of the musculature it resembles the last species closely. In the thorax, however, the transverse parallel muscle bands are more regular and more frequent, while the longitudinal bands are fewer in number, and in the case of some of the Ascidiozooids almost entirely absent (Pl. X. fig. 10).

The connective tissue elements present no notable peculiarity; a few fusiform and stellate corpuscles are scattered in the homogeneous transparent membrane connecting and surrounding the muscle fibres. The mantle is lined on its inner aspect with the usual layer of squamous epithelium, which is often distinctly visible in this species without any staining (Pl. XI. fig. 4). The ectoderm on the outer surface is in its

normal condition. The muscular siphons of the two apertures closely resemble those of the last species, both in appearance and minute structure.

The transverse muscle bands are very strong (Pl. X. fig. 10, and Pl. XI. fig. 3), each being composed of several parallel bundles of fibres, and they are placed so closely that they must form a powerful ejaculatory apparatus when suddenly contracted. On the right side of the thorax, these strong circular muscle bands do not extend so far down as to cover the part of the peribranchial cavity which represents the incubatory pouch. Probably this is to prevent the expulsion of embryos before they are ready; while, when developed and fit to leave the maternal atrium, they have advanced into its anterior muscular part. Over the endostyle in the ventral median line the circular bands break up, interlace, and unite with portions of neighbouring bands so as to form a reticulum in that region (Pl. XI. fig. 3).

Branchial Sac.—In this species there is no indentation on the ventral border, the sac having an oblong or somewhat pyriform outline (Pl. X. fig. 10). Its structure is simple, being formed of transverse and small longitudinal vessels, with the addition of internal transverse vessels (or horizontal membranes) which run round the inside of the sac, one at the level of each transverse vessel, and are connected at the ends with the dorsal and ventral trunks. They are of small calibre, rather thick walled, and covered externally with short cilia, and are distinctly seen when the sac is viewed from the inside (Pl. XI. fig. 5, *h.m.*).

The stigmata which lie between the longitudinal vessels are of small size but very numerous, and have the form of elongated ellipses (Pl. XI. figs. 5, 9, 10). There are in the adult sac from twelve to eighteen (usually about sixteen) rows on each side, and an average of forty stigmata in each row, making about twelve hundred stigmata (six hundred on each side) in the entire sac. The walls of the vessels have the usual structure, but the ciliated cells surrounding the stigmata are often of a slightly different form from those already described. They are not so pointed as the conical form in the last species, being more globular or quadrangular and often not showing much difference between the attached and the free ends (Pl. XI. figs. 6, 7); the barrel-shaped kind do not occur in this species. The nuclei are distinctly circular in outline and are placed nearer to the attached than to the ciliated end of the cell.

The Endostyle has the usual structure. It extends in a single curve from the branchial aperture along the ventral margin of the branchial sac to the posterior end. Seen from the ventral or dorsal aspects (Pl. XI. fig. 8) it is nearly straight, not being thrown into a series of curves as in the last species. Viewed from the side (Pl. XI. fig. 2), its posterior extremity is seen to turn dorsally, nearly at right angles to its former course, and extend for a short distance in the direction of the œsophageal aperture. The minute structure of the endostyle is similar to that of the last species.

The Dorsal Lamina is represented by a series of large flat triangular processes or

languets, which are attached to the muscular band running along the dorsal edge of the branchial sac. This band is seen best from the outside, and is of considerable breadth. A languet springs from it at its intersection with each of the transverse vessels of the sac (Pl. XI. fig. 9). Each languet has the form of a greatly drawn out isosceles triangle, and at the base its edges are in connection with the ends of the internal transverse vessels running along the inner surface of the branchial sac (Pl. XI. fig. 10). The edges of the languet are composed of columnar cells bearing short cilia, continuous with those on the internal transverse vessel. The languets are about 0·2 mm. in length, and are generally thrown into one or more curves. The rather blunt apex of each extends to the base of the next below, and sometimes beyond it, when they are placed pointing posteriorly.

Tentacles.—Eight is the normal number of tentacles in this species, but seven and nine have been also observed. They are all of the same length, and are placed in a circle in the usual position anterior to the peripharyngeal band (Pl. XII. figs. 1, 2). They are rather shorter and stouter than those of the last species and are placed much closer to the peripharyngeal band, but are otherwise very similar in appearance and minute structure.

The Peripharyngeal Band requires no special description, as in structure and relations it exactly resembles that already described in the last species. The same may be said of the prebranchial zone and the ciliated band at the base of the tentacles, but a structure placed above or anterior to the tentacular circlet requires a short notice. It presents the appearance of a number of curiously shaped tentacles of different sizes arranged in a circle and directed outwards so as to meet and be overlapped by the true tentacles (Pl. XII. fig. 1). They form a series of irregular finger-like processes depending from the edge of a zone-like thickening of the mantle near the base of the siphon, and forming a sort of rudimentary diaphragm (Pl. XII. fig. 2). A similar structure is seen at the base of the atrial siphon, where, however, it is more rudimentary, being present only as a thickened undulating line (Pl. XII. fig. 3).

Neural Gland and Dorsal Tubercle.—Here, as in the last species, these obscure organs are difficult to distinguish on account of their opacity. On the ventral and anterior surfaces of the nerve ganglion there is a small oval or pyriform opaque yellowish-brown body (Pl. XII. fig. 1), which is, there can be little doubt, the neural gland. Continued from its anterior end towards the circlet of tentacles is a somewhat conical or funnel-shaped opaque body with the wider end anterior. Its walls in an optical section are seen to be formed of columnar cells, and the interior is occupied by large cilia pointing posteriorly. This is the neural duct, and its anterior end seems to be a simple circular aperture as in *Colella pedunculata.*

The Nerve Ganglion is of small size and is elliptical in shape. It is placed nearer to the branchial than to the atrial aperture (Pl. XII. fig. 3), and gives off nerves at its ends.

Alimentary Canal.—The abdominal part of the alimentary canal is very opaque, being of a dark indigo-blue colour. This gives the colony its peculiar tint, and it is caused by the blood-corpuscles, which are nearly black, being collected into small clumps which fill the large sinuses extending through the mantle.

The œsophageal opening, placed at the posterior end of the branchial sac, near the dorsal margin, is of large size, and has the edge and its inner surface for a short distance down thrown into a remarkable series of folds, presenting curiously complicated ridges and tooth-like processes (Pl. XII. fig. 4). The œsophagus is short and wide, and opens into the slightly larger stomach, which is continued without much diminution in size into the intestine, the first portion of which forms with the stomach and œsophagus a slightly curved antero-posterior line. The intestine having reached the posterior end of the abdomen, turns sharply round and runs forward parallel to the stomach; then curving upwards, crosses the anterior part of the œsophagus, and after a short rectal course through the peribranchial cavity, ends in a rather prominent anus, the margin of which is disposed in a series of regular folds (Pl. XII. fig. 4). The stomach is not plicated, and there is no typhlosole in the intestine (Pl. XII. fig. 8).

Vascular System.—The heart is placed on the right side of the body in the abdominal region, and lies in the elongated space between the stomach and the intestine. It is a long fusiform undulating tube with very thin walls, which are seen under a high power to contain closely placed transverse fibres which sometimes exhibit a fine cross striation, and are circular in section. Outside this muscular coat is a thin layer of connective tissue, consisting of a delicate membrane in which fusiform and branched corpuscles are imbedded.

Reproductive Organs.—The genital glands are situated on the left side of the abdomen (Pl. XII. fig. 6), to which they are more closely applied than in the last species. In this case the male organs greatly predominate. A large number of oval or pyriform pale yellow vesicles with granular contents are scattered over the surface of the intestine. These are the spermaria or testes. They are in connection with short and fine ducts which unite into about a dozen larger ones, and these converge towards and open into the lower end of a large opaque yellowish-brown vas deferens, which runs up the inner edge of the intestine towards the atrium (Pl. XII. figs. 6, 7).

Usually in the adult Ascidiozooid no ovary is visible (Pl. XII. fig. 6). Rarely one or two large ova are seen among the testes, and more frequently one, two, or three mature ova are found occupying different positions on their way to the atrium (Pl. XII. fig. 6). In young Ascidiozooids, however, from the base of the colony (see p. 96), the ovary is well developed, and exactly resembles that of the last species (see Pl. XII. fig. 8). These circumstances seem to indicate the existence of protogyny, each Ascidiozooid being first female and then male, and the ova of those near the base being fertilised by the spermatozoa of the older ones farther up the colony. An Ascidiozooid such as the one

represented in figure 6 is just ending its female stage of existence and preparing to function as a male.

Incubatory Pouch.—In the present species this organ is so slightly developed that it is doubtful whether it should be considered as existing at all. The embryos merely lie in an enlargement of the base of the peribranchial cavity.

On examining the thorax of a fully developed Ascidiozooid from the right side, two, three, or four large mature ova are noticed, forming a transverse row, which extends from the dorsal edge three-fourths of the way round the posterior end of the thorax towards the endostyle (Pl. XI. fig. 2). Generally the dorsal end of the row projects more or less beyond the margin of the thorax, and is then contained in a sac-like diverticulum of the mantle, having no muscular bands. From the ventral end of this transverse row of ova a series of embryos in different stages of development extends in an oblique antero-posterior direction from the base of the endostyle towards the atrial aperture. The most posteriorly placed of these is only slightly more advanced in development than the ovum next it, while the embryo at the anterior end of the line is a tailed larva ready for expulsion (Pl. XI. fig. 2). Thus a regular series is formed from the dorsal end of the sac across the posterior end and then along its length to the atrial aperture, the embryos being arranged in order of development. These series of ova and embryos merely lie in the peribranchial cavity, and are covered by the mantle, which they push out so as to form a sac-like diverticulum, which only differs from the incubatory pouch of the last species in degree of development and in not being so much constricted off from the rest of the peribranchial cavity. This arrangement rather supports the view (suggested on p. 89) that in *Colella pedunculata* the incubatory pouch may possibly be formed after the ova and embryos have all arrived in the peribranchial cavity. It is obvious that if in *Colella thomsoni* (see Pl. XI. fig. 2) the region of the peribranchial cavity occupied by embryos were constricted off to form an incubatory pouch commencing with the posterior end of the dorsal edge, the youngest embryos would be placed at the far end of the pouch and the tailed larvæ would be next the mouth—exactly the arrangement found in *Colella pedunculata*.

The Process of Budding.—In this species, as in the case of *Colella pedunculata*, gemmation takes place in the peduncle. The vascular appendages have the same structure as in the last species. Each is divided by a median septum into two canals running side by side. The wall is formed of squamous epithelium, the ectoderm, lined by a delicate layer of connective tissue. The ectodermal cells are polygonal and distinctly nucleated (Pl. XIII. fig. 5). These vessels and their lateral branches contain many blood-corpuscles —in some places the small vessels, and especially some short cæcal processes which occur on their sides, are completely filled up with them (Pl. XIII. figs. 1, 4). Every here and there in the cavities of the vascular appendages occupying the larger canals of the stalk minute buds or spherical aggregations of cells are found (Pl. XIII. fig. 8 *gm'*).

These are from 0·02 to 0·06 mm. in diameter, but no larger (see Pl. XIII. fig. 1). They are of a yellowish-brown colour, and so opaque that no structure can be made out in their interior. The method of formation of these young buds was not directly observed, but in all probability they arise as in the case of the last species by the aggregation and proliferation of a number of the blood corpuscles surrounded by an ectodermal layer derived from the wall of the vascular appendage. The only specimen showing a stage in the early formation of a bud is the one represented in figure 9, where an outer layer of cells is seen separating off from the ectodermal wall of the vessel (*ec.*), while the free mesoderm cells inside are becoming arranged along the wall and in some places are proliferating. Some of these cells have become enlarged (*o.*) and already look like the ova which they become later on. Just as in *Sarcobotrylloides wyvillii*, young ova are conspicuous in the bud from a very early period (Pl. XIII. figs. 7, 8).

In transverse sections of the stalk, until the very top is reached, no further development of the buds is seen except a slight increase in size. Just below the head, however, there is a narrow zone where buds are found in various stages of development from the simple spherical double-walled sac up to the young Ascidiozooid (Pl. XIII. figs. 7, 8). The course of development is apparently the same as in the last species. Sections showing the archenteron divided into three, the dorsal nerve tube, the ventral endostyle, the posterior ovary, and lastly the elongation of the abdominal region may all be seen. It is remarkable, however, that the earlier stages, showing the division of the archenteron and the formation of the endostyle, which were those most commonly seen in sections of the peduncle of the last species, are here much rarer than the later stages, where the ovary and intestine have made their appearance (see Pl. XIII. fig. 7).

The buds in this species seem to remain, when in the condition of two membranes surrounding an archenteron, in a dormant condition undergoing no change except a slight increase in size, until they have reached the top of the stalk, where they rapidly pass through the stages of their development which had been delayed, and appear in the form of young Ascidiozooids (Pl. XIII. fig. 10) which then continue to grow slowly in size until they arrive at the base of the head. This course of development would explain the comparative rarity of buds in the earlier stages, which were passed through more rapidly. In some cases the buds do not become completely constricted off from the vessels as in *Colella pedunculata*, but remain attached by their posterior ends up to a late period in their development (see Pl. XIII. fig. 8). Figure 10 shows a young Ascidiozooid in which all the chief systems of the body, including the genital glands (*ov.* and *t.v.*), and even the digestive gland (*h. gl.*) on the intestine, are already present.

The Formation of the Colony.—In this species the colony seems to be more stable and to undergo change less rapidly than in the case of *Colella pedunculata*. This may be inferred from the observed facts, that the Ascidiozooids are more of the same size, the differences between those at the opposite ends of the head not being very great; that

there is little or no bare patch at the summit of the colony, suggesting that the Ascidiozooids are rarely cast off; and lastly, that there is not such a complete gradation between the buds at the top of the peduncle and the young Ascidiozooids at the base of the head. The buds are not produced in such numbers, and they probably go through their development as a whole more slowly than in the last species. The young Ascidiozooids added to the base of the colony will therefore be fewer in number, and will occur at rarer intervals. Each Ascidiozooid in the head will live longer, and the death and decay of those at the summit will not occur so frequently. This of course only applies to a colony in a full grown and flourishing condition. When young the budding will no doubt be more rapid; and when old the death of the Ascidiozooids and the decay of the colony will certainly increase greatly in its rate, and be accompanied by a diminution in, or entire stoppage of, the process of gemmation.

Colella gaimardi, n. sp. (Pl. XIV. figs. 7–14).

The Colony has the form of a more or less rounded mass, the head, attached by a peduncle. The head is usually flattened in one direction. The peduncle tapers downwards slightly to the point of attachment. The colour is dull yellow, passing in some parts into drab or brown. The surface is even and moderately smooth. No common cloacal apertures are visible.

The length of the head is 9 mm., the breadth 10 mm., and the thickness about 5 mm.

The length of the peduncle is about 2 cm., and the thickness at the middle about 2 mm.

The Ascidiozooids are elongated antero-posteriorly, and are rather large, usually about 3 mm. in length and 1·5 mm. in greatest breadth. They are not arranged regularly. The abdomen is large and has a rounded posterior end from which a vascular appendage is prolonged through the common test.

The Test is soft and gelatinous. The outer layer on the head is firmer and has a smooth glistening outer surface. It is very transparent. The homogeneous colourless matrix is crowded with cells of various sizes and shapes. A few very small bladder cells are present, but no pigment cells.

The Mantle is fairly strong. The musculature is regular and well developed. It consists mainly of transverse bands.

The Branchial Sac is delicate. The transverse vessels are rather narrow and are all of the same size. The stigmata are long and narrow.

The Dorsal Lamina consists of a series of short pointed languets.

The Tentacles are very short. There are eight, and they are all of the same size.

The Alimentary Canal is large.

The Reproductive Organs are not very conspicuous. A large incubatory pouch projects from the dorsal edge of the peribranchial cavity.

Locality.—Port William, Falkland Islands; January 27, 1876; depth 5 to 10 fathoms.

Four large colonies and one very young one are included in this species. They were obtained at Port William, on the eastern coast of the Falkland Islands, from a depth of 5 to 10 fathoms.

The above description and measurements were taken from three of the larger specimens. The fourth differs slightly, but is not sufficiently distinct to be placed in a separate species. The head is larger and flatter, so as to be somewhat discoid, but its lower end is broader than the upper, and has a truncated appearance. The exact dimensions are as follows:—Length of the head 13 mm., breadth 16 mm., average thickness 4 mm. Length of the stalk 18 mm., thickness at the upper end 3·5 mm., at the lower end 1 mm. The colour in this specimen is rather paler than in the other three, the head being yellow with no tinge of brown, and the peduncle a clear light grey, except the point of attachment, which is slightly brownish.

The very young colony consists of a peduncle about 8 mm. long, and a rounded head scarcely 2 mm. in length and about 1·5 mm. in breadth.

In all the specimens the form of the colony is club-shaped (Pl. XIV. fig. 7), and the peduncle tapers from the base of the head to the point of attachment. There is a certain amount of variability in regard to the lateral compression and also in the position of the broadest part of the colony. The peduncle is always of a lighter colour than the head, and is much greyer than the peduncle of *Colella pedunculata*.

The Ascidiozooids are very distinct; they are large and are closely placed. They appear as opaque yellow spots which may be as much as 2 mm. in greatest diameter (Pl. XIV. fig. 7). This is not the anterior end alone; on account of the irregularity in the position of the Ascidiozooids, a considerable part of the body in many cases shows through. There seems to be no regular arrangement of the Ascidiozooids in lines or groups, and they are not imbedded in the test at right angles to the surface of the colony, but lie inclined at various angles. In transverse sections they are seen to occupy nearly the whole of the interior of the head, there being no central free region of the test. The size of the Ascidiozooids varies greatly. The broadest part is generally where the stomach is placed. The vascular appendage is long and narrow. In the younger Ascidiozooids (see Pl. XIV. fig. 12) it is about twice the length of the body. Its lower end is rounded and usually a little swollen, forming a knob.

The cells in the test are extremely numerous and of fairly large size (Pl. XIV. fig. 9, *t.c.*). Their processes are in some cases very long and branched. The mantle has its muscle bands mainly transverse in direction.

The branchial sac is thin-walled and readily torn. The stigmata are large with narrow ends (Pl. XIV. figs. 8, 11, *sg.*). There are at least four rows on each side of the sac.

The endostyle is fairly straight. It is conspicuous. The languets are very short, and they are not united by a membrane in the middle dorsal line (see Pl. XIV. fig. 11, *l*); the stigmata pass in a continuous series from the one side of the branchial sac to the other across the dorsal edge.

The tentacles are remarkably short. They are merely small triangular stumps and seem to be in quite a rudimentary condition. They form a marked contrast with the well-developed tentacles of other members of the genus, such as *Colella pedunculata.*

The nerve ganglion and neural gland form an ellipsoidal mass, with an anterior prolongation, the neural duct, which opens just inside the prebranchial zone by a simple aperture, the dorsal tubercle.

The alimentary canal is large and conspicuous. In the young Ascidiozooids, of which there are a great many in the colony, it is much elongated antero-posteriorly (see Pl. XIV. fig. 12). The œsophagus in the figure is rather larger than in most of the other specimens examined, but it is always of considerable length. The stomach is oval in shape, and along with the œsophagus runs directly backwards, forming the dorsal part of the visceral mass. After the stomach comes a short and very narrow piece of intestine which usually has a small posteriorly directed cæcal process (Pl. XIV. figs. 12, 13). This forms the termination of the visceral mass. Figure 13 shows the shape of this region of the canal in another specimen. The intestine then enlarges (Pl. XIV. fig. 13, *i.*), and turning anteriorly runs forward to cross the œsophagus, and thus enters the dorsal part of the peribranchial cavity. The ventral part of the visceral mass is formed by the long intestine. In the older Ascidiozooids the alimentary canal is not so much elongated as in the younger ones, the stomach is more globular, and the intestine is relatively shorter and wider. The vascular appendage arises rather on the ventral edge of the posterior end of the abdomen (Pl. XIV. fig. 12, *v.ap.*).

In the intestinal loop, and just alongside the stomach, a number of small ova, forming a compact mass, are always found in the young Ascidiozooids (Pl. XIV. fig. 12). In older ones one or two large mature ova are generally still present, but in addition there are always some ovate opaque seminal vesicles and a vas deferens. In most of the mature Ascidiozooids the dorsal part of the peribranchial cavity is prolonged into an incubatory pouch of considerable size (Pl. XIV. fig. 10). It is usually sac-shaped, with a very narrow mouth, and was never observed to be spirally coiled. These incubatory pouches are filled with embryos in various stages of development, and a large number of tailed larvæ are also present. In the larvæ (Pl. XIV. fig. 14) the body is narrow and elongated, and the tail is very long, being in some cases capable of being wound nearly twice around the body. A very broad delicate membrane fringes the tail upon each

side, but does not seem to have any supporting transverse fibres such as are present in some Ascidian larvæ. The single pigmented sense organ of the larva is placed very far back in the body.

Colella pulchra, n. sp. (Pl. XV. figs. 1–13).

The Colony has the form of a somewhat elongated mass, the head, borne on the summit of a long narrow peduncle. The head is not flattened laterally, and its upper end is usually rather wider than the lower, which tapers into the top of the peduncle. The widest part is about the middle of the head. The peduncle is thickest at the top, where it joins the head, and from that point tapers downwards to the point of attachment, where it usually expands again slightly. The surface is even and smooth. The colour is a dull red. The peduncle is rather paler than the head.

The length of the head is 10 mm., the greatest breadth or thickness 4 mm. The length of the peduncle is about 2·5 cm., and its thickness about the middle 0·5 mm.

The Ascidiozooids are small, less than 1 mm. in length. They are slightly elongated antero-posteriorly, and are placed nearly at right angles to the surface; they incline somewhat inwards and downwards towards the base of the colony. They are arranged in regular vertical rows, which are more or less distinctly placed in pairs.

The Test in the head is soft and gelatinous, that of the peduncle is firmer. The transparent homogeneous matrix contains bladder cells of moderate size, and also the usual small fusiform and stellate cells. The latter are not numerous. The test is to a very great extent occupied by the Ascidiozooids and the embryos, which are numerous and closely placed.

The Mantle is very delicate. The muscle bands are very thin, and they are not numerous. They run chiefly in a transverse direction over the thoracic region of the body.

The Branchial Sac is short, and of a more or less quadrangular form. The transverse vessels are moderately wide, and are all of the same size. The stigmata are long and narrow, they are regularly arranged. The ciliated cells bounding them are convex at their free ends.

The Dorsal Lamina is formed of a series of short blunt triangular languets.

The Tentacles are about twelve in number. They are long and narrow.

Locality.—Station 187, September 9, 1874; lat. 10° 36′ S., long. 141° 55′ E.; depth, 6 fathoms; bottom, coral mud.

About a dozen specimens of this beautiful little species were dredged in Torres Strait between Australia and New Guinea, from a depth of 6 fathoms. The dimensions given above are those of the largest colony. An average sized one has the head about 7 mm.

long and 3 mm. broad. The youngest specimen (Pl. XV. fig. 2) consists of a stalk about 2 cm. in length, bearing at its upper end an elongated thickening in which there are some young Ascidiozooids, especially at the top, where a fairly complete ring is formed by six or seven of them. This colony has scarcely any colour, the entire peduncle and the greater part of the young head being of a pale grey. The Ascidiozooids show as small dull red spots. The next youngest colony has an ovate head with the narrower end downwards. It is 5 mm. long and 3 mm. broad at the widest part, the peduncle is about 2 cm. in length. The head is not of such a dark red colour as in the other specimens, and the Ascidiozooids are smaller.

The other colonies seem mature, and have all much the same appearance (Pl. XV. fig. 1). The head is always much longer than broad, and is not compressed laterally. The top is wide, and has in some cases a truncated appearance. The lower end is narrow, and tapers to the top of the peduncle. The general red colour of the head is seen on a close examination to be due mainly to the bodies of the Ascidiozooids, which are seen plainly as little rounded spots about 0·5 mm. in greatest diameter. They are placed closely side by side in vertical rows (Pl. XV. fig. 1), of which there are usually ten to twelve in a head. Towards the lower end of the rows they become gradually smaller and smaller, while at the top they are full size. Each Ascidiozooid has upon its anterior end a minute white speck of pigment just visible to the eye, and here and there, between the rows of Ascidiozooids, larger masses of white pigment are to be seen.

Under a low power of the microscope (40 diameters) it is clearly seen that the test is of a greyish colour, while the Ascidiozooids are red. The branchial apertures are distinctly visible, and around each may be traced the elliptical peripharyngeal band (Pl. XV. fig. 6, *br.*). The mass of white pigment is now seen to be placed on the anterior extremity of the endostyle, and the rows are clearly seen to be placed in pairs, the Ascidiozooids in each pair having their endostyles turned towards one another, while their dorsal edges are next the space between that row and the adjacent one (Pl. XV. fig. 6). In each row also the Ascidiozooids are placed semi-alternately and lie obliquely, so that their ventral edges are nearest to the base of the colony.

The peduncle is clearly seen to be formed by a central axis of a dull red colour enclosed by an outer layer of transparent grey test (Pl. XV. fig. 9). Here and there the red axis seems broken up into pieces, and, in some places, minute rounded spots of a darker red are present. In sections (Pl. XV. fig. 11) it is seen that the peduncle consists of a continuation of the test, and it has a thin external layer which is homogeneous and firm. Inside this comes a broad zone containing very many bladder cells, while the central region is more solid again, but has numbers of large pigment cells of various sizes and shapes, and here and there a young embryo (Pl. XV. fig. 11, *em.*). It is this central zone which appears red from the exterior, and its colour is due to the numerous pigment cells scattered through it (see Pl. XV. figs. 9, 10, 11). The embryos, either singly or in

groups, cause the irregular appearance of darker red spots in the axial portion. Throughout all parts of the peduncle (Pl. XV. fig. 11) the ordinary minute test cells are found in the otherwise homogeneous matrix. A few thin-walled vessels (Pl. XV. fig. 11, *v.ap.*) are also to be seen in both transverse and longitudinal sections. They traverse the peduncle in its length (Pl. XV. fig. 9, *v. ap.*), and seem to give off no lateral branches.

The Ascidiozooids are decidedly small (Pl. XV. fig. 7). The visceral mass is a little larger than the branchial part of the body. The vascular appendage is delicate, and springs from the middle of the posterior end of the body. It is clearly divided into two tubes running side by side. The anterior end of the Ascidiozooid is not large. It bears the short wide branchial siphon. The dorsal edge of the branchial part of the body is more convex than the ventral.

The test in the head is very soft. As the Ascidiozooids and embryos are very numerous, the test is greatly broken up. There is no large central part of the colony formed of test alone. Bladder cells are abundant, but they are nearly always spherical, not being so numerous as to be compressed into polygonal forms. The ordinary small cells of the test are abundant and of all shapes. The vascular appendages, which are found every here and there in the test, are thin and delicate. They are usually filled with blood-corpuscles.

The musculature of the mantle is very fine. In addition to the regular transverse bands there are some bundles of fibres crossing the others irregularly. There is a good deal of white pigmentation in the mantle. In addition to the patch at the anterior extremity of the endostyle there are sometimes clumps of cells scattered over the branchial region, and almost invariably there are large areas of the stomach (Pl. XV. fig. 7, *st.*) and intestine which have a granular opaque white appearance from the presence of numerous pigment cells.

The branchial sac is nearly as broad as it is long. There are usually four or five rows of stigmata on each side. The transverse vessels (Pl. XV. fig. 3, *tr.*) are moderately wide; they have delicate horizontal membranes attached to their inner edges. The sac shown in figure 5 was probably not from a mature Ascidiozooid. The stigmata are relatively short and rounded, and all the parts are small. Figure 3 shows the shape of the stigmata in a fully developed condition. The stigmatic cells are very conspicuous under a high power. They are short, and their free ends project usually in a somewhat triangular form (see Pl. XV. fig. 4). The cilia are abundant.

The dorsal languets are rather blunt at their ends. They have more of a triangular form when seen from above or below than from the side as in figure 5. A strongish band of muscle fibres may be traced along the dorsal line of the branchial sac outside the base of the languets (Pl. XV. fig. 5, *d.l.*). The tentacles are long and thin. In several of the Ascidiozooids they were found projecting through the mouth of the branchial siphon

when the test was removed. The endostyle is conspicuous. Its ends are bent abruptly in a dorsal direction (Pl. XV. fig. 7, *en.*).

The alimentary canal is large and conspicuous (Pl. XV. fig. 7). The œsophagus commences at the dorsal edge of the posterior end. It is a short and wide tube, and leads directly backwards to the large globular stomach, which is opaque and thick walled but perfectly smooth, having no ridges or folds. From the dorsal edge of the stomach, near its posterior end, there projects a small pyriform body (Pl. XV. fig. 7, *ap.*). This is seen, when more highly magnified (Pl. XV. fig. 8), to be a short knob-like vascular appendage from the mantle over the stomach, or just where the stomach joins the intestine. It is thin walled, but always contains a number of large pigmented blood-corpuscles of a red colour. The blood-corpuscles all over the body are of a reddish colour, and thus give the Ascidiozooid and the whole colony the characteristic red tint, but the corpuscles in this vascular appendage always seem larger and redder than elsewhere. What the use of this structure is I am unable to say. The intestine springs from the posterior end of the globular stomach and turns at once ventrally and then forwards in a curve which gives the posterior end of the body its rounded shape (Pl. XV. fig. 7). The rectum crosses the œsophagus to gain the dorsal side of the peribranchial cavity. The intestine is wide throughout its whole course.

The reproductive organs lie alongside the intestine, and project on the one hand into the intestinal loop and on the other beyond the intestine ventrally (Pl. XV. fig. 7, *ov.*). They are hermaphrodite in the mature Ascidiozooids, consisting of one or two large ova and a number of spermatic vesicles. Many embryos in various stages of development, and some tailed larvæ, were found in the common test, but no incubatory pouches were observed.

Figure 12 shows one of the most advanced larvæ which were found in the colony. The shape of the body is elongated, rounded at both ends, and widest in the middle. The tail is still present, but the branchial sac is well developed, three or four rows of stigmata being visible. At its front end the larva is provided with two large adhering papillæ. The endostyle is conspicuous and is directed transversely to the longitudinal axis, the future mouth being placed in the middle of the dorsal surface of the larva. The pigmented eye is conspicuous behind the mouth at the one end of the dorsal edge of the branchial sac, while the urostyle begins at the other end close to the œsophageal aperture. The œsophagus bends ventrally to open into the stomach, which lies directly behind the branchial sac. The intestine first runs ventrally, then turns posteriorly, and then curves round dorsally and a little anteriorly, and disappears behind the stomach. The test is well developed all over, and contains a large number of bladder cells.

Figure 13 represents part of another far advanced larva more highly magnified. The endostyle (*en.*) is a conspicuous curved body bounding the branchial sac ventrally. The branchial sac is well developed, and shows four rows of stigmata. At its anterior

end the young tentacles are seen, and in front of them *br.si.* points to the ectoderm in the region of the future branchial siphon. This indicates the anterior end of the Ascidian and the middle of the dorsal surface of the larva. Outside the ectoderm (*br.si.*), the test (*t.*) with its numerous large bladder cells is seen. A single sense organ is present, and is still large and well developed (*ot.*). Around it and between it and the tentacles are some masses of cells (*c.m.*), which are probably nervous. Behind the sense organ (nearer to the posterior end of the larva) is a distinct opening (*ap.*) through both test and ectoderm. The character of the ectodermal cells changes greatly at this point. Over the sense organ they are almost squamous, but as they approach the opening they become gradually cubical and then low columnar in form; finally, where they turn inwards to line the short tube leading from the aperture (see Pl. XV. fig. 13, *ap.*), they become tall, narrow, columnar cells. On the other side of the opening the same changes are seen, the flattened ectoderm cells of the posterior end of the larva becoming first cubical and then columnar. Probably this invagination of the ectoderm at the dorsal edge of the anterior end of the Ascidian is the origin of the atrial aperture. Further back, along the dorsal edge of the branchial sac, is seen the base of the urostyle (*u*), which is continued out into the tail, while still further back is found the œsophagus (*œ.*) leading into the globular thick-walled stomach (*st.*). This larva is very remarkable on account of the advanced state of its organisation while still in a completely larval condition. The branchial sac, the endostyle, and the alimentary canal are well developed, while the urostyle, the pigmented sense organ, and the larval adhering papillæ are still present.

Colella elongata, n. sp. (Pl. XVI. figs. 1–7).

The Colony is elongated and rudely conical. It is not flattened, and is probably attached by a stalk springing from the posterior wider end. The upper free end is narrow, but rounded. The surface is rather uneven, but fairly smooth. No common cloacal apertures are visible. The colour is a dull yellowish-grey, darker towards the lower and lighter towards the upper end.

The length is 3 cm., the greatest breadth is 1 cm., and the thickness about 1 cm.

The Ascidiozooids are elongated antero-posteriorly, and placed at right angles to the surface. They are usually about 1·5 mm. in length and 1 mm. in breadth. The anterior end is broad, and bears both the apertures. The posterior is narrower, and is continued into the long narrow vascular appendage, which, turning downwards, traverses the common test to the base of the colony.

The Test is soft. Its outer layer is smooth and firmer than the deeper parts, which are very soft and spongy. It is not very transparent, and has a greyish colour. In sections

the homogeneous matrix is seen to be occupied by very numerous cells of small size and various shapes. No large bladder cells or pigment cells are present.

The Mantle is fairly strong. The musculature is well developed. The bands are somewhat irregular in their course, but are mostly transverse.

The Branchial Sac is rather short and wide. The stigmata are few but very large; they are long and narrow, with parallel sides and rounded ends. The cells bearing the cilia are short and prominent.

The Endostyle is conspicuous. It has a very irregular course, taking a number of undulations dorso-ventrally.

The Tentacles are numerous and closely placed. There are at least sixteen large ones and the same number of smaller ones placed alternately.

Locality.—Port Jackson, Sydney, Australia; depth, 30 fathoms.

This species is founded for the reception of a single damaged specimen obtained in Port Jackson from a depth of 30 fathoms. Probably the colony was attached by a stalk (whether long or short there is no means of determining) springing from its lower and wider end. What remains of the colony is an irregularly conical body, tapering upwards from a point a little way above the base (Pl. XVI. fig. 1). This is the widest part; below it the body rapidly narrows to the place where it has been torn from its stalk. The breadth and the thickness are in most parts of the colony very much the same. The general shape is more like that of *Colella thomsoni* than of *Colella pedunculata*, but is narrower and more elongated than either of them. The upper part is narrow and tapering. Its end is rounded (Pl. XVI. fig. 1). The surface is smooth and glistening at the top, but becomes more irregular and rougher towards the base of the colony.

The Ascidiozooids are visible on the surface as small light grey opaque marks about 0·5 mm. in diameter. They seem to be scattered quite irregularly over the surface (Pl. XVI. fig. 1). They are equally abundant all over, except on the lower one-fourth or so of the colony, where they are fewer in number than elsewhere. In a transverse section across the middle of the colony (Pl. XVI. figs. 2, 3), the Ascidiozooids are seen to occupy a zone about 1·5 mm. in depth round the outside, while the central part is formed by the colonial test penetrated by the very conspicuous vascular appendages.

The breadth of the Ascidiozooid varies from half to two-thirds of its length. The branchial region (thorax) is generally rather larger than the visceral (abdomen). The anterior extremity is much broader than the posterior (Pl. XVI. fig. 5). The branchial aperture is placed near its middle, while the atrial siphon extends outwards from its dorsal end. The vascular appendage, which springs from the posterior end of the abdomen, is very long, and nearly as wide as the intestine (Pl. XVI. fig. 3). After leaving the body it runs for a short distance towards the centre of the colony, but very soon turns downwards in the direction of the stalk, so that in any section through the

middle of the colony only the upper ends of the appendages belonging to the Ascidiozooids in that section are seen. The remainder of these appendages would appear in sections further down the colony in the direction of the stalk.

The test, considering its soft and unmodified condition, is very untransparent. This is possibly due to the presence of the numerous opaque vascular appendages which run through it. Figure 4 in Plate XVI. shows the number present in a small piece of test from the middle of a section. The cells in the test are extremely abundant. The matrix, though generally homogeneous, is in some places distinctly fibrillated. Small spherical bladder cells are present in some places.

The mantle musculature is very like that of *Colella pedunculata*. The branchial sphincter is fairly well developed. The atrial siphon is large and projecting (Pl. XVI. fig. 5, *at.*).

The branchial sac is rather irregular in shape. Its ventral border is always much contorted on account of the remarkably irregular course of the endostyle (Pl. XVI. fig. 5, *en.*). Its anterior and posterior ends are wide, and usually almost straight and parallel to one another. The stigmata are very long, as in *Colella pedunculata*. The stigmatic cells are prominent and richly ciliated. The tentacles are very large, and are so closely placed that their bases touch (Pl. XVI. fig. 7, *tn.*). The shorter ones are scarcely half the length of the larger ones.

The alimentary canal is of fair size; it is slightly variable in its shape and course. The œsophagus is always long and narrow (Pl. XVI. fig. 5). It commences at the dorsal end of the posterior edge of the branchial sac, and runs directly or almost directly backwards (posteriorly) to open into the small more or less globular stomach (Pl. XVI. figs. 5, 6, *st.*). The stomach usually lies about half way between the posterior end of the branchial sac and the posterior end of the Ascidiozooid. It has no markings externally, and is quite opaque. The intestine commences as a narrow tube like the œsophagus, and after a very short course backwards usually opens suddenly into a considerably wider region with thick walls (Pl. XVI. fig. 6, *i.*). This narrows slightly as it runs backwards to form the most posteriorly placed part of the intestine, which turns dorsally and then anteriorly to become the rectum. The rectum is long and very wide (Pl. XVI. figs. 5, 6). It runs anteriorly past the stomach and œsophagus and along the dorsal edge of the branchial sac, to terminate at the base of the large atrial siphon. It is usually filled with fæcal matter in the form of spherical dark coloured balls (Pl. XVI. fig. 5), which are moderately firm and strong. Figure 6 shows the alimentary canal of a younger Ascidiozooid than the one represented in figure 5.

The reproductive organs are placed alongside the loop of the intestine, and a few ova and spermatic vesicles may frequently be seen (as in Pl. XVI. fig. 5), projecting beyond the rectum dorsally, opposite to the stomach.

Colella quoyi, n. sp. (Pl. XIV. figs. 1–6).

The Colony consists of a more or less rounded mass attached by a short peduncle. The upper part or head is usually rounded at the top and broader at the lower end. It may be flattened somewhat in one direction. The surface is even and very smooth. No common cloacal apertures are visible. The colour is light grey. The lower part of the head is sometimes darker than the stalk and the upper part.

The length of the head is 1·3 cm., the breadth 1·5 cm., and the thickness 0·9 cm. The length of the peduncle is about 0·8 cm., and its average thickness 0·5 cm.

The Ascidiozooids are elongated antero-posteriorly, and are placed at right angles to the outer surface. They are about 2 mm. in length and 1 mm. in breadth. The anterior end is moderately broad, and bears the branchial aperture. The posterior is rounded, and is formed mainly by the reproductive organs.

The Test is moderately firm and solid. The outer layer is smooth and is specially firm. It is of a light grey colour, but very transparent. In sections the homogeneous matrix shows very many small cells of various shapes scattered through it. Very few large bladder cells and no pigment cells are present.

The Mantle is thin. It is fairly muscular over the branchial sac, but membranous on the viscera. The muscle bands are rather irregular in their course.

The Branchial Sac is wide and rather thin. The transverse vessels are narrow and all of much the same size. There are four rows of stigmata, containing from twelve to twenty each. The stigmata are long and narrow with pointed ends.

The Endostyle is conspicuous. It is bent considerably at its anterior and posterior ends.

The Dorsal Lamina is in the form of a series of triangular languets. They are not long.

The Tentacles are placed close together. There are about twelve, all of the same length.

The Alimentary Canal is comparatively small and simple.

The Reproductive Organs are very large, and form the greater part of the visceral mass.

Locality.—Cascade Bay, Kerguelen Island; depth, 25 fathoms.

Three specimens of this species were obtained in Cascade Bay, Kerguelen Island, at a depth of 25 fathoms. Two of them (see Pl. XIV. fig. 1) are very much alike, and correspond to the description given above. The third specimen is a little different (Pl. XIV. fig. 2). The head is more regular in shape, and narrows more at the lower end than in the other two specimens. The Ascidiozooids are arranged more or less regularly in vertical lines. Each line is formed of two rows in which the Ascidiozooids alternate, so as to form a series of zigzag lines extending up from the base. The

upper one-fourth or so of the head is free from Ascidiozooids, being formed of test alone, and having a slightly decayed appearance. The peduncle of this specimen is regular in shape, and differs considerably from those of the other two specimens. It is narrow at the top where it joins the head. It then swells rapidly to (7 mm.) about twice its original thickness, and then tapers downwards, somewhat like a carrot, to a narrow base by which it is attached. This peduncle has a very slight yellowish tinge, and is marked by delicate transverse wrinkles.

In the other two specimens (Pl. XIV. fig. 1) the head is more compressed (*i.e.*, the thickness is not so great as the breadth), and the Ascidiozooids seem quite irregularly scattered over the surface. They are in all cases more numerous near the base of the head than further up. The peduncle is equally thick all the way down, and has no yellow tinge.

The Ascidiozooids are clearly visible in all the specimens; they show as opaque whitish-grey areas about 1 mm. in diameter. In a transverse section across the middle of the colony the Ascidiozooids are seen to occupy a zone a little over 2 mm. in breadth, surrounding a central mass of test about 3 or 4 mm. in breadth.

The branchial region of the body is nearly of the same size as the visceral (see Pl. XIV. fig. 5), and they are connected by a narrow neck formed of the œsophagus (*œ*), the rectum (*i.*), and the vas deferens (*v.d.*) covered by a layer of mantle. The branchial aperture (*br.*) is placed nearly in the centre of the wide anterior end, while the atrial siphon (*at.*) projects from the dorsal side. There are apparently no vascular appendages.

The test is firmer even in the centre of the colony than is usual in allied species. It is very transparent, which is no doubt partly due to the absence of vascular appendages from the Ascidiozooids. The test cells are very abundant, and they are of fairly large size. Bladder cells are rare, and seem to be mainly if not solely in the superficial layer of the test.

The mantle musculature is like that of *Colella pedunculata*. The sphincters are fairly strong, and there is a well-developed branchial siphon (Pl. XIV. fig. 5, *br.*). Longitudinal muscle bands radiate from the base of both apertures, and form an irregular network over the sides of the branchial part of the body (see Pl. XIV. figs. 5, 4).

The branchial sac is nearly as wide as it is long (Pl. XIV. fig. 5). The stigmata are large, a circumstance which gives the sac a delicate appearance. The narrow pointed ends of the stigmata (Pl. XIV. fig. 3) form a constant characteristic. The ventral border of the branchial sac is very convex, and this causes the endostyle to bend almost in a C-shaped curve (Pl. XIV. fig. 5, *en.*). The course of the endostyle is slightly undulating. The languets are shorter and stouter than usual. The tentacles are not large, and they are peculiarly closely placed, the line of their insertion forming a very small circle. The prebranchial zone is large, and is particularly wide at the ventral edge, where the anterior extremity of the endostyle is very distant from the base of the ventral tentacles.

The alimentary canal is comparatively inconspicuous, and is usually more or less hidden by the reproductive organs (Pl. XIV. fig. 5). The œsophagus (*œ.*) commences rather at the dorsal side of the posterior end of the branchial sac, and leads directly backward in a funnel-like form (Pl. XIV. fig. 6, *œ.*) to the anterior end of the stomach. The stomach is not large, and seems to vary a little in its exact shape. In some cases (Pl. XIV. fig. 5, *st.*) it is elliptical with narrow ends, which pass gradually the one into the œsophagus and the other into the intestine, but in one Ascidiozooid examined the stomach was truncated at the anterior end and the funnel-shaped œsophagus entered it in a slight depression (see Pl. XIV. fig. 6, *st.*). The stomach was long and nearly equally wide throughout its anterior three-fourths, which was directed dorsally and posteriorly. The remaining fourth narrowed rapidly, and turned abruptly so as to form a right angle with the front part and point ventrally and posteriorly. The posterior end was only about half as wide as the anterior, and narrower than the intestine (Pl. XIV. fig. 6, *i*). The intestine is in all cases a rather narrow tube, which runs posteriorly and then ventrally, and turns anteriorly with a wide curve leaving an open loop (Pl. XIV. fig. 5). It crosses close to the anterior end of the œsophagus, and then becomes the rectum, which is continued up the dorsal edge of the branchial sac towards the atrial aperture.

The genital glands are very large, but in all the Ascidiozooids examined consist of the male system only. There are a number of large ovate and pyriform seminal vesicles, forming together a mass about four times as large as the stomach (Pl. XIV. fig. 5, *g.*). They fill up the greater part of the intestinal loop, and project beyond the intestine posteriorly and ventrally for a considerable distance. Thus the posterior half or so of the visceral mass is usually formed by the reproductive organs. Each seminal vesicle has a short narrow duct, and the various ducts join to form a very large vas deferens, which leaves the mass at its posterior end (Pl. XIV. fig. 5, *v.d.*), and, curving round ventrally and then anteriorly, forms the ventral border of the greater part of the visceral mass. Eventually the vas deferens reaches the rectum, along with which it crosses the base of the branchial sac to reach its dorsal edge. In the whole of its course the vas deferens is a most conspicuous object. It is usually nearly as wide as the intestine (see Pl. XIV. fig. 5), and takes up stain very readily.

Colella murrayi, n. sp. (Pl. XVII. figs. 1–11).

The Colony is rudely club-shaped, consisting of a large expanded head supported by a short stout peduncle. The head is longer than it is broad, and is flattened laterally. The upper end is wide, and has an unevenly truncated appearance. The highest point is in the middle. The lower end tapers into the peduncle. The sides of the head are nearly straight. The peduncle is shorter than the head, and is not flattened laterally. It is not wide relatively to the head, but is strong. The surface is even, and fairly smooth.

The colour is a light grey, with a yellowish tinge over the head. There is a certain amount of opaque white pigment in the test.

The length of the head is 2·5 cm., the greatest breadth 1·8 cm., and the average thickness 0·8 cm. The length of the peduncle is 1·5 cm. and its thickness 0·6 cm.

The Ascidiozooids are comparatively small. They are elongated antero-posteriorly, and measure about 1·5 mm. in length and 0·5 mm. in greatest breadth. The branchial and visceral parts of the body are distinct, and a narrow vascular appendage is prolonged from the posterior end of the body through the common test.

The Test is firm and moderately tough. In the peduncle it is especially tough. With the exception of the superficial layer of the head it is rather opaque, and this layer becomes opaque only where the white pigment is deposited.

Bladder cells are present in large numbers, especially in the superficial layers. Consequently the structureless matrix is greatly reduced. It contains the usual small cells of various shapes; most of these are rounded or fusiform, and in some parts, especially of the peduncle, they are extremely abundant. In the central part of the head and peduncle the test is very spongy in its coarser structure, and is penetrated by the numerous vascular appendages.

The Mantle is thin and membranous. The musculature is very weak, consisting merely of very delicate bundles of muscle fibres, most of which run transversely. The branchial sphincter is moderately strong.

The Branchial Sac is large. The transverse vessels are of a fair size and all alike. The stigmata are long and narrow, with rounded ends. They are arranged with regularity. The stigmatic cells are short, and pointed at their free ends. They are richly ciliated.

The Dorsal Lamina is formed of a series of short pointed languets.

Locality.—Station 163D, June 12, 1874; lat. 33° 57′ 30″ S., long. 151° 39′ 15″ E.; depth, 120 fathoms; bottom, green sand.

Two specimens of this interesting species were obtained off the south-east coast of Australia from a depth of 120 fathoms. They differ slightly from one another in appearance, but must certainly be placed under the same species.

The head, which is large compared with the peduncle (Pl. XVII. fig. 1), is flattened laterally, and becomes thinner as it recedes from the peduncle, so that in lateral view it is somewhat wedge-shaped. In a front view (Pl. XVII. fig. 1), on the other hand, it narrows as it approaches the peduncle, and the broadest point is close to the uneven upper end. At the base the head passes quite gradually into the top of the peduncle, and there is no line of demarcation between the two. The upper end of the head looks at first sight as if it was partially decayed and torn, but a careful examination does not afford any evidence of this being the case. Although there are no Ascidiozooids in the terminal 2 to 3 mm. (Pl. XVII. fig. 2), still the test seems whole and healthy

looking. The head varies in its thickness from 1 cm. a short distance above the peduncle to 0·5 cm. at the upper end. One surface of the head is much more convex than the other, but this is probably an individual variation.

The peduncle is strong, and is almost circular in section. It is narrowest a little below the base of the head, and then expands slightly towards its lower end (Pl. XVII. fig. 1). The actual point of attachment is not present in the specimen figured, but must have been immediately below the torn end. The peduncle is entire in the other specimen, and is somewhat irregular in form at the point of attachment.

The general colour of the colony is a light grey, but the head has a slight but warm yellowish tinge, except at the very base, at the upper end, and along a series of lines which run vertically between the rows of Ascidiozooids. At these points the colour is still grey, or even in places white, and is seen on a close examination to be due to a large number of small rounded masses of opaque white pigment imbedded in the test. This pigment is most abundant at certain points between the rows of Ascidiozooids, and at the top of the colony (Pl. XVII. fig. 2), and is present in much greater quantity in one of the specimens than in the other, thus making a considerable difference in the external appearance of the two colonies. The surface is not perfectly smooth, but appears to be very finely roughened (Pl. XVII. fig. 8).

The Ascidiozooids are clearly visible on the surface of the colony (Pl. XVII. fig. 1). They show as opaque yellowish-grey areas about 1 mm. in diameter. They are smallest at the base of the head, and increase in size as they are traced upwards. They are arranged with great regularity in vertical lines, and these rows are placed in pairs, each pair being separated from its neighbours by ridges of test from 1 mm. to 1·5 mm. in width. It is in these areas that the vertical bands of white pigment are developed (Pl. XVII. figs. 2, 8). In each pair of rows the Ascidiozooids are placed alternately so as to form a zigzag line (Pl. XVII. figs. 1, 2). The longest row of Ascidiozooids is 2·2 cm. from base to top. The bodies of the Ascidiozooids extend inwards nearly at right angles to the surface, but only occupy a zone about 1·5 mm. in width. The remainder of the head is formed by a spongy mass of test, penetrated in all directions by the vascular appendages of the Ascidiozooids. In a vertical section the lower part of the head and the peduncle are seen to be marked by delicate longitudinally running fibres. This appearance is due to the vascular appendages. The thoracic region of the Ascidiozooid is larger than the abdominal (Pl. XVII. fig. 9). It is nearly as broad as it is long, while the alimentary and reproductive viscera form a rather narrow mass elongated antero-posteriorly.

As a whole the test is firmer than usual in this species. The outer layer of the head forms a strong but thin transparent membrane, in certain parts of which aggregations of white pigment are formed between the anterior ends of the Ascidiozooids (Pl. XVII. fig. 4, *p.c.*). The test of the inside of the head is more tough and spongy in its nature, and is rather opaque. The peduncle, although very much vacuolated, is firm

and tough, and quite opaque except in thin sections or at the edges, where it has a slightly hyaline appearance. In its histology the test differs considerably in different regions. The outer layer in the head contains great numbers of bladder cells, and the matrix is consequently reduced to a reticulum (Pl. XVII. fig. 8). Between the bladder cells numbers of the usual small rounded and fusiform cells are present, and here and there large pigment corpuscles are met with. These are like bladder cells in shape, and are usually larger, but they are filled with granular masses of opaque white pigment (Pl. XVII. fig. 8, *p.c.*).

The peduncle is traversed by longitudinally running canals which contain the vascular appendages. These canals are nearly circular in cross section (Pl. XVII. fig. 5), and give the tissue its coarsely spongy texture. The test between these canals is in its outer parts (Pl. XVII. fig. 6) filled with bladder cells and great numbers of small cells, many of which are most beautifully branched, their processes extending through the structureless matrix to great distances. In the centre of the peduncle the tissue is much more dense. Bladder cells are absent, while the smaller cells are very peculiar; they are nearly all larger than elsewhere, and of a circular or rudely square or oblong shape (Pl. XVII. fig. 7, *p.c.*). They stain with picrocarmine a homogeneous red tint, and show no nuclei.

The mantle is singularly weak (Pl. XVII. fig. 9). In some cases the muscle bundles contain only a single delicate muscle fibre each. On these the nuclei are seen as distinct fusiform swellings. The atrial siphon is large, but has no distinct sphincter (Pl. XVII. fig. 9, *at.*).

The transverse vessels of the branchial sac (Pl. XVII. fig. 3, *tr.*) are rather wide, and have delicate horizontal membranes. The stigmata are very like those of *Colella gaimardi* (Pl. XIV. fig. 8.).

The alimentary canal is narrow (Pl. XVII. fig. 9). The œsophagus is long but narrow; it runs nearly directly backwards, and opens into the anterior end of the somewhat ovate stomach (Pl. XVII. fig. 9, *st.*). The stomach is not large, and its walls are smooth. It tapers posteriorly towards the intestine, which runs backwards and turns round ventrally and then anteriorly forming a narrow loop. It crosses the œsophagus to become the rectum, running up the dorsal edge of the branchial sac.

The reproductive organs form a large ovate mass placed in the intestinal loop, and extending beyond the intestine ventrally and posteriorly (Pl. XVII. figs. 9, 10, *g.* and *t.v.*). It was formed entirely in all the Ascidiozooids examined by opaque ovate spermatic vesicles. Each of these has a short narrow duct (Pl. XVII. fig. 11), and these join together at the posterior end of the body to give rise to the vas deferens (Pl. XVII. figs. 9, 11, *v.d.*). This tube is conspicuous throughout its whole course. It curves round ventrally and then anteriorly from its point of origin, and ascends along the ventral edge of the visceral mass until it reaches the rectum. At its upper end for a short distance it becomes swollen to about twice its ordinary calibre.

The relation of the genital organs to the alimentary canal is seen in a transverse section of the abdomen (Pl. XVII. fig. 10). This section must have been cut obliquely with the dorsal edge more anterior than the ventral, as the spermatic vesicles do not usually extend so far forward as the stomach. Probably a line connecting *g.* and *st.* in figure 9 would be nearly in the plane of the section. The vas deferens in the transverse section (Pl. XVII. fig. 10, *v.d.*) lies further from the intestine than it generally seems to be in surface views and dissections. The space between the stomach and intestine is occupied by the heart, in the walls of which cross striped fusiform muscle fibres are distinctly visible.

Colella murrayi, var. *rubida*, nov. (Pl. XVII. figs. 12–14).

The collection contains a small colony which was dredged from Station 162,[1] in Bass Strait, at a depth of 38 fathoms, and which I was at first inclined to regard as belonging to *Colella murrayi*. A closer examination, however, revealed several points of difference, so that I have thought it best to place this specimen as a variety of that species. It is unnecessary to give here a formal description; that belonging to the last species will serve, if the various differences to be enumerated presently are borne in mind.

The colony (Pl. XVII. fig. 12) consists of a short, somewhat triangular head, borne on the summit of a short thick peduncle. The head is flattened laterally, and has a truncated appearance at the top, which is the widest point. The sides slope downwards, the head tapering gradually into the peduncle. The extreme length of the head is 7 mm., the greatest breadth almost 10 mm., while the thickness varies from 5 mm. at the base of the head, where it joins the peduncle, to 3 mm. at the top. The peduncle is between 6 and 7 mm. in length and about 5 mm. in thickness. It expands considerably at the base where attached. It is not flattened laterally.

From the above description it is clear that this colony (Pl. XVII. fig. 12) agrees very closely in general form with the specimens described under the last species. The colour, however, is very different. In the present case the whole colony is of a somewhat ruddy brown colour. There is no distinction between the tint of the peduncle and that of the head, but the extreme top of the colony (Pl. XVII. fig. 12) is slightly lighter and more transparent than the rest. There is no white pigmentation in any part of the specimen. The surface is even, but distinctly rougher than in the last species, being finely granulated all over both head and peduncle.

The Ascidiozooids are comparatively few in number, and seem smaller than in the last species. They are arranged in the same manner, but the vertical rows are not quite so distinctly marked off into pairs (Pl. XVII. fig. 12). There are about one hundred and twenty Ascidiozooids altogether in the colony, and they form twelve pairs of vertical

[1] Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ E.; depth, 38 fathoms; bottom, sand and shells.

rows. The ends of the Ascidiozooids at the surface are very small, and show merely as small dark brown points. No common cloacal apertures are visible in any part of the colony. The Ascidiozooids are largest at the top and smallest near the base of the head. Their vascular appendages can be faintly seen in a very good light as dark streaks running down the peduncle.

Sections show at once that the brown colour of the colony is due to a very large number of small clear yellowish-brown pigment corpuscles of a rounded shape which are scattered through nearly all the tissues of the body. In the test, which is otherwise very much the same as in *Colella murrayi*, they are present in the outer layers scattered through the matrix between the bladder cells. They are present in large quantities in some parts of the mantle, especially along the dorsal line and round the base of the branchial siphon. The musculature of the mantle is remarkably feeble, and, where pigment cells are absent, this membrane is perfectly transparent. The branchial aperture is distinctly six-lobed, and the siphon is fairly strong.

In the branchial sac the transverse vessels do not seem quite so wide as in *Colella murrayi*. The stigmata are regular. They are long, with rounded ends, and are usually considerably wider than the fine longitudinal vessels between them (Pl. XVII. fig. 14, *l.v*). The ciliated cells are distinct.

The endostyle is conspicuous. It is long and straight. The tentacles are short and stout. There are eight, four longer and four shorter placed alternately (Pl. XVII. fig. 13, *tn.*, *tn'.*).

Altogether the main difference between the colony under consideration and those belonging to *Colella murrayi* is in the pigmentation. The latter are entirely free from yellowish-brown pigment corpuscles, and are very remarkably coloured in places by opaque white granules, while in the former no white pigmentation is present, and the entire colony is coloured by small round clear yellowish-brown pigment corpuscles. This produces such an entirely different aspect, not only in the colony as a whole, but also in the various organs separately, that I think the specimen is worthy of being regarded as a marked variety, but certainly not as a distinct species.

Colella ramulosa, n. sp. (Pl. XV. figs. 14–17).

The Colony is composed of one or more rounded masses borne on long branched peduncles. The rounded mass or head is usually irregularly flattened in one direction. The peduncle is very irregular in its course and in its thickness. The colour of the head varies from light to very dark grey. The peduncle is always of a straw yellow colour. The surface is uneven but smooth. No common cloacal apertures are visible.

The length of the head is 12 mm., the breadth 9 mm., and the thickness 4 mm. The length of the peduncle is about 5 cm., and the thickness 2 mm.

The Ascidiozooids are much elongated antero-posteriorly, and are large. They are usually fully 3 mm. in length, and a little over 1 mm. in greatest breadth. They are not arranged with regularity. The posterior end is prolonged into a narrow vascular appendage.

The Test is very soft and flexible. The outer layer of the head is smooth but not firm. It is very transparent. There are few cells in the homogeneous matrix.

The Mantle is thin and delicate. The muscle bands are fairly strong but distant. The branchial sphincter is large.

The Branchial Sac is of considerable length. There are at least four rows of long stigmata. The transverse vessels are wide. The stigmata are large and are arranged with great regularity.

The Dorsal Lamina is formed of short languets.

The Tentacles are very long. There are about twelve, and they seem all of much the same size.

The Alimentary Canal is large, and forms the greater part of the visceral mass.

Locality.—Station 311, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ W.; depth, 245 fathoms; bottom, blue mud; bottom temperature 46° F.

Most of the specimens of this species were obtained from a bottle labelled "Compound Ascidians and Gorgonoids from various dredgings, hardened in absolute alcohol." As, however, one small colony was found, along with some specimens of Didemnidæ, in a bottle from Station 311, on the west coast of Patagonia, it is probable that all the specimens of the species were obtained from that locality.

There are eleven or twelve more or less perfect heads and a large number of peduncles, many of them mere fragments. The dimensions given above are those of the largest head; two or three of the smaller ones are only 3 or 4 mm. in greatest length. Most of the specimens are more or less torn or injured. The largest colony has three heads remaining, and the peduncle branches six times. The colony figured (Pl. XV. fig. 14) is smaller, but more complete. Usually the peduncle simply bifurcates at each division, but in one or two cases (Pl. XV. fig. 15) three branches spring from the same point. Some of the fragments of peduncle are very long, and give off many branches. They are frequently incrusted with foreign objects, and in all probability lay on the sea-bottom. They are much too weak to support the weight of the head in an upright position even in water, and their irregular winding courses suggest that they have been recumbent.

The general shape and appearance of the head is very like that of *Colella pedunculata*, but the branched peduncle is quite peculiar. The colour of the head varies much. In the smaller specimens it is a light grey, while in larger ones it is darker, and in the largest it is a very dark grey indeed. The peduncle does not vary so much in

colour. It is always more or less of a straw yellow, in some cases a little brighter than in others.

The Ascidiozooids are always clearly visible on the surface. They are closely placed but have no regular arrangement (see Pl. XV. fig. 14). At the upper end of the head they seem to be rarer than elsewhere, or absent. This part of the colony sometimes has a decayed appearance. The shape of the Ascidiozooids is long and narrow (Pl. XV. fig. 17).

The branchial sac occupies about one-half of the total length, and is considerably narrower than the widest part of the body, which is towards the posterior end of the visceral mass (Pl. XV. fig. 17). The vascular appendage (*v.ap.*) is narrow, and springs from the middle of the posterior end.

The test contains a fair number of small cells scattered through the homogeneous matrix. Bladder cells are present in some places, but they are not very numerous. Some parts of the test contain very few cells indeed. The mantle is not strong. In some places it contains patches of large opaque white pigment cells. These are especially developed along the course of the endostyle towards its anterior extremity, and frequently form a pigmented mass which may be seen by the naked eye in a surface view of the colony, showing through the transparent test as a small white speck. The endostyle is large and conspicuous; its course is undulating.

The branchial sac is peculiarly long and narrow (Pl. XV. fig. 17). The transverse vessels are wider than is usual in the genus (Pl. XV. fig. 16, *tr.*), and have narrow horizontal membranes. The stigmata are large, but numerous; they have rounded ends, and are bounded by very distinct ciliated cells pointed at their free ends. The tentacles are long and thin, and their bases are closely placed.

The abdomen is as long as and broader than the thoracic part of the body, and is almost entirely formed by the alimentary canal. The œsophagus commences at the narrow posterior end of the branchial sac and runs backwards to open into the large globular stomach which forms a rounded projection upon the dorsal edge of the abdomen (Pl. XV. fig. 17, *st.*). The stomach is perfectly plain; it has no ridges or folds. The intestine springs from the posterior end of the stomach and runs first posteriorly, then curves round ventrally and turning anteriorly runs forwards, and eventually crosses the œsophagus to become the rectum, which may be traced nearly half way up the dorsal edge of the branchial sac (Pl. XV. fig. 17, *r.*).

The reproductive organs form a rounded mass placed in the intestinal loop, and projecting beyond the intestine ventrally and to a slight extent posteriorly (Pl. XV. fig. 17, *t.v.*). They consist in all the Ascidiozooids examined merely of spermatic vesicles, no ova being present. These Ascidiozooids were all large and mature, no young ones being found in the colony examined. The vas deferens (Pl. XV. fig. 17, *v.d.*) leaves the genital gland at its posterior end and curls round ventrally and then anteriorly to reach

the intestine, which it crosses about the level of the œsophagus, so as to come to lie on the dorsal edge of the rectum, along which it runs to its termination.

No incubatory pouches or larvæ were found in the colony.

Colella concreta, n. sp. (Pl. XVI. figs. 8–16).

The Colony takes the form of a number of irregularly club-shaped masses united together by their lower ends, where they are attached to some foreign object. Each club-shaped mass consists of an upper more or less rounded head, the part occupied by the bodies of the Ascidiozooids, and a thick irregular stalk tapering downwards to the point of attachment.

The general colour is yellowish-grey. The test of the head is light grey, while the Ascidiozooids show through as opaque light yellow bodies. The surface of the head is even and smooth; that of the stalk is slightly uneven in places and not very smooth. No common cloacal apertures are visible.

The average length of one of the club-shaped masses is about 3 cm. The length of the head is usually about 8 mm., its breadth 13 mm., and its thickness 11 mm. The usual length of the stalk is 2 cm., its breadth at the top 6 mm., at the base 2 mm.

The Ascidiozooids are elongated antero-posteriorly, and are placed mostly at right angles to the upper surface of the colony. They are about 3 mm. in length and 1 mm. in greatest breadth. The anterior end is moderately wide. It bears both apertures. The thoracic region is usually not quite so large as the abdomen. The posterior end is narrow, and is continued into a slender vascular appendage which extends downwards through the test, usually for about 3 mm., and then terminates in a bulb.

The Test is very soft and delicate. The outer layer on the upper surface of the head is smooth and glistening, and is firmer than the deeper parts. The stalk is stronger than the test of the head, and is more opaque.

The matrix is homogeneous, and contains great numbers of rather large fusiform and stellate cells. No bladder cells or pigment cells are present.

The Mantle is fairly strong on the branchial part of the body; over the viscera it is thin and membranous. The chief muscle bands run transversely and are regularly placed.

The Branchial Sac is small and thick walled. It contains about eight rows of stigmata on each side. The alternate transverse vessels are larger than those between them. The stigmata are rather narrow and are closely placed.

The Endostyle is very conspicuous. Its course undulates greatly from side to side, especially towards its posterior end.

The Dorsal Lamina is formed of a series of large pointed triangular languets.

The Tentacles are not large, but they are fairly numerous. There are about sixteen, all of the same size.

The Dorsal Tubercle is a small circular opening at the base of the most anterior languet.

The Alimentary Canal is large and conspicuous.

The Reproductive Organs lie alongside the intestine. The adult Ascidiozooids are hermaphrodite.

Locality.—Kerguelen Island; depth, 10 to 60 fathoms.

One very large colony and several smaller specimens of this species were collected at Kerguelen Island from depths of 10 to 60 fathoms.

The larger colony (see Pl. XVI. fig. 8) consists of about thirty irregularly club-shaped masses all joined together by their lower ends. Each of these may be called a system.[1] The smaller systems are each merely a small knob, the upper rounded free end of which contains a few young Ascidiozooids, while the lower part, consisting of a mass of test penetrated by the vascular appendages, forms a short stalk. In the larger systems the shape is much more irregular. The head expands laterally so as to become more flattened on the upper surface, which, however, is always a little convex (Pl. XVI. fig. 8). This upper surface is more or less circular in outline, and has a well-defined edge from which it rapidly narrows downwards to the top of the stalk. The length of the head (from the top of the stalk to the highest point of the convex upper surface) is usually considerably less than the average diameter of its upper surface. In a head the length of which is 8 mm., the average diameter is about 12 mm.

The stalk, even in the largest systems, remains narrow at its lower fixed end, but thickens greatly and in some cases very irregularly as it is traced upwards to the head (Pl. XVI. fig. 8). There is a great deal of variability both in length and thickness of stalk, but on an average the top is about three or four times as thick as the base.

The general shape and appearance of the small systems is very like that of many specimens of *Amaroucium proliferum*, while the larger systems approach more the forms seen in the genus *Distaplia*.

The colour of the colony approaches yellow rather than grey. The stalk is yellowish-grey and nearly quite opaque. Here and there a more yellow and more opaque line may be seen running longitudinally for a short distance. This is caused by a vascular appendage lying close to the surface.

The test of the head is distinctly greyer and more transparent, allowing the yellow opaque bodies of the Ascidiozooids to show through with considerable clearness. In one or two systems openings resembling common cloacal apertures were found about the middle of the upper surface of the head, but in most cases, on account of the extreme delicacy of the superficial layer of test, it is impossible to make them out.

[1] The relation of these masses to the regular systems, of *Botryllus* for example, is difficult to determine from spirit specimens; possibly some of them have more than one common cloacal aperture, and are therefore equivalent to several true systems.

The Ascidiozooids are apparently arranged quite irregularly. There are about fifty in a head of average size. Their anterior ends form light yellow areas rather less than 1 mm. in diameter on the upper surface of the head. The Ascidiozooid is large, and has a curious shape (Pl. XVI. fig. 9). The branchial aperture is quite at the ventral edge of the anterior end, and is clearly six-lobed. The atrial siphon is larger than the branchial (Pl. XVI. fig. 11, *at.*), is not quite at the dorsal edge, and is not lobed. The endostyle is long and nearly straight, and forms a conspicuous border to the ventral edge of the branchial sac. This ventral edge is the longest part of the sac; the dorsal edge is considerably shorter. The visceral part of the body (abdomen) is in most cases rather larger than the branchial region, and is narrowed anteriorly and posteriorly (Pl. XVI. figs. 9, 11). The vascular appendage (Pl. XVI. fig. 9, *v.ap.*) is usually at least as long as the rest of the Ascidiozooid. It is conspicuous and of moderate width, and runs almost directly backwards towards the stalk. It ends in an ovate bulb, which occupied about one-fourth of the length of the appendage.

The cells of the test are extremely numerous. Most of them are fusiform, with very long fibres projecting from their narrow ends. The nuclei are large and take up stain readily. Small bladder cells are present in some parts of the test.

The mantle is strong on the branchial part of the body. There are a small number of strong muscle bands which run transversely. They are regularly arranged and usually equidistant (Pl. XVI. fig. 12). The sphincters are strong, especially that around the branchial siphon. Over the viscera the mantle is thin and almost destitute of musculature. Here and there, especially over the stomach, patches of opaque white pigment cells occur, and smaller groups may be sometimes seen upon the branchial siphon. The vascular appendage has a few longitudinally running muscle bands (Pl. XVI. fig. 10), which are continued down from the mantle.

The branchial sac is very narrow (Pl. XVI. fig. 11). Its posterior end is pointed, and lies at the ventral edge of the body. The larger alternate transverse vessels have a few muscle fibres. The stigmata are long and narrow, and are very regularly arranged (Pl. XVI. fig. 13, *sg.*).

The tentacles are long and thin, but not very large. They are all of much the same size (Pl. XVI. fig. 14, *tn.*). The dorsal languets are very large. They are of a long triangular form, and are flattened antero-posteriorly; their edges are ciliated (Pl. XVI. fig. 14, *l.*). Their bases are connected by a strong band of muscle fibres (Pl. XVI. fig. 14, *d. l.*), which occupies the median dorsal line of the branchial sac.

The alimentary canal is, relatively to the size of the branchial sac, very large (Pl. XVI. fig. 11). The œsophagus begins at the dorsal edge of the posterior end of the sac, and runs straight backwards; it is very short. The stomach is large and ovate in shape, with the long axis directed antero-posteriorly. The stomach forms the greater part of the ventral edge of the visceral mass (Pl. XVI. fig. 11, *st.*). It is smooth externally,

and is opaque. When split open or sectionised it is seen to have a very large number (varying from twenty-five to forty in the various stomachs examined) of folds in its interior (see Pl. XVI. fig. 15). These folds are not very prominent, but are closely placed; they run longitudinally, but are not continued over the entire length of the organ. They frequently branch, and new folds commence at various points, thus producing undulations in the course of the neighbouring ones. Figure 15 represents not a surface view of the folds, but an optical section, obtained by focussing down a little from the inner surface. In this way the columnar cells which form the folds are seen in profile; *gr.* indicates the groove between two folds, and *fd.* the centre of a fold.

The stomach opens on the dorsal side of its posterior end into a very short piece of narrow intestine, which at once dilates into a large globular cavity, forming the posterior and dorsal part of the visceral mass (Pl. XVI. fig. 11). This is continued at its anterior extremity into a small funnel-shaped piece of intestine, which, after a slight constriction, opens into the long rectum. This part of the tube is narrow at its commencement, and runs anteriorly and slightly ventrally to reach the œsophagus. It then runs straight forwards, swelling slightly as it goes, and finally terminates in the anus, which is placed at the base of the atrial siphon (Pl. XVI. fig. 11, *at.*). The anterior part of the rectum is very large, and is usually distended with dark-coloured fæcal matter. Viewed as a whole, the alimentary canal is remarkable for its large size and for the irregularity in its calibre. The intestine lies throughout its entire course on the dorsal side of the stomach.

All the Ascidiozooids examined were hermaphrodite, there being one or two large ova along with the spermatic vesicles (Pl. XVI. figs. 9, 11). The latter (Pl. XVI. fig. 11, *t.v.*) stain more deeply with picrocarmine than the ova, and are large, opaque ovate bodies, placed in groups on the side of the intestine, and projecting beyond it on the dorsal edge and posteriorly. Each Ascidiozooid has a large bunch of from six to twelve vesicles (Pl. XVI. fig. 16, *t.v.*). The delicate ducts from the vesicles join at the base of the long and wide vas deferens, which is a conspicuous object running alongside the rectum throughout its entire length.

Distaplia, Della Valle.

Distaplia, Della Valle, Nuove Contribuzioni alla storia naturale delle Ascidie Composte, &c., Reale Accademia dei Lincei, 1880–81, p. 18.

Distaplia, von Drasche, Die Synascidien der Bucht von Rovigno, Wien, 1883, p. 22.

Colony in the form of lobed masses or club-shaped knobs.

Systems distinct, each one forming a knob or lobe of the colony.

Ascidiozooids elongated antero-posteriorly, and placed vertically in the colony. Branchial aperture six-lobed. Atrial aperture provided with a languet.

Test gelatinous, penetrated by ectodermal prolongations from the Ascidiozooids.

Branchial Sac with four rows of long stigmata.
Dorsal Lamina represented by short languets.
Alimentary Canal posterior to the branchial sac. Stomach ovate, smooth-walled.
Reproductive Organs placed on the right side of the intestinal loop. The ova develop in an incubatory pouch formed as a diverticulum from the atrial cavity. The larva is of large size, and is gemmiparous.

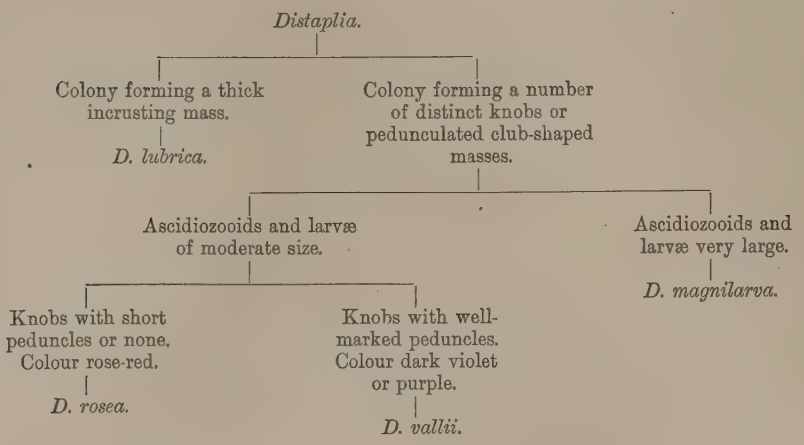
This genus was founded in 1881 by Della Valle[1] for two species of Compound Ascidians from the Mediterranean which he named *Distaplia magnilarva* and *Distaplia rosea*. He pointed out at the same time that Oscar Schmidt's *Cellulophana pileata*,[2] which F. E. Schulze had shown in 1877[3] to be not a Sponge but an Ascidian, and Kowalevsky's *Didemnium styliferum*,[4] which is certainly not one of the Didemnidæ, would probably find their proper places in the new genus.

In external appearance, as Della Valle pointed out, *Distaplia* resembles colonies of the genus *Aplidium*, but there the resemblance ends, and its true affinities are with *Cystodytes* and *Distoma*. It is therefore placed quite correctly by von Drasche in the family Distomidæ, but it is also allied with his family Chondrostachyidæ, being united to *Chondrostachys* and *Oxycorynia* by the new Challenger genus *Colella*.

A new species, *Distaplia lubrica*, from the Gulf of Rovigno, was added to the genus by von Drasche in 1883, and in the same year I found in the collection of Tunicata obtained during the "Porcupine" and "Lightning" expeditions a specimen of *Distaplia*, which in my Report[5] upon that collection I referred provisionally to *Distaplia rosea*, Della Valle. This specimen, which was dredged in Tangier Bay, Morocco, from a depth of 35 fathoms, is discussed further on. Finally, in the Challenger collection there occur several small colonies obtained from Station 212, near the Philippine Islands, which undoubtedly belong to the genus *Distaplia*, and closely resemble the specimen from Tangier Bay. They do not, however, agree well with any of the previously described species. They differ entirely from von Drasche's *Distaplia lubrica* in the form of the colony, and they differ in certain characters from each of Della Valle's species while agreeing with each of them in other features. Consequently it is necessary to consider these "Porcupine" and Challenger specimens as belonging to an independent species, which may be regarded as occupying a position between *Distaplia magnilarva* and *Distaplia rosea*. I have named it *Distaplia vallii* in honour of the founder of the genus.

The four known species of the genus may be distinguished briefly by the following characters :—

[1] Nuove Contribuzioni, &c., Roma, 1881.
[2] Spongien des Adriat. Meeres, 1862.
[3] *Zeitschr. f. wiss. Zool.*, Bd. xxix. p. 119.
[4] Ueber die Knospung der Ascidien, *Archiv f. mikrosk. Anat.*, Bd. x., 1874.
[5] *Trans. Roy. Soc. Edin.*, vol. xxxii., part ii., p. 219, 1884.


Distaplia.
Colony forming a thick incrusting mass.
D. lubrica.
Colony forming a number of distinct knobs or pedunculated club-shaped masses.
Ascidiozooids and larvæ of moderate size.
Ascidiozooids and larvæ very large.
D. magnilarva.
Knobs with short peduncles or none. Colour rose-red.
D. rosea.
Knobs with well-marked peduncles. Colour dark violet or purple.
D. vallii.

Distaplia vallii, n. sp. (Pl. XVIII. figs. 1 to 6).

The Colony consists of one or more rounded or dome-shaped masses or heads borne on the summit of well-marked peduncles. The upper surface of the head is convex, and its widest part always exceeds the peduncle in diameter. The peduncle is usually two or three times as long as the head, and is nearly as wide. At the top it passes gradually into the base of the head, and at its lower end it may be united by stolon-like processes to the other parts of the colony. The surface is even but not very smooth.

The colour of the peduncle is light grey with a rosy tinge. The head varies from red in its lower part through violet and purple to nearly black at the top.

The length of the head is 7 mm., its greatest breadth is 9 mm. The length of the peduncle is 15 mm., and its average thickness 5 mm.

The Ascidiozooids are elongated antero-posteriorly and are placed vertically in the colony. Each is about 2 mm. in length, and has the body divided into two regions (the thorax and the abdomen) of nearly equal size.

The Test is soft. It is of a grey colour, and is fairly transparent. The external layer in the head contains a good deal of dark pigment. Small test cells are numerous and of various shapes, but there are no bladder cells.

The Mantle is thin but fairly muscular. The muscle bands are fine but numerous, most of them run transversely. In some places the mantle is considerably pigmented.

The Branchial Sac is large. There are four rows of long stigmata. Each of these is crossed by a narrow transverse vessel which does not interrupt the stigmata.

The Dorsal Lamina is formed of a series of short triangular languets.

The Tentacles are not large. There are eight of much the same size and some smaller intermediate ones.

Localities.—(*a*) Tangier Bay, on the coast of Morocco; depth, 35 fathoms. One large colony with two heads, obtained during the cruise of H.M.S. "Porcupine" in 1870. (*b*) Station 212; lat. 6° 54′ N., long. 122° 18′ E.; depth, 10 to 20 fathoms; January 30, 1875; bottom sand.

The species of this genus appear to be very variable in shape and pigmentation, and it is a difficult matter to determine how far external characters are of value as diagnostic features. The above specific description is taken from the largest of the Challenger specimens obtained at the Philippine Islands, and the other smaller specimens agree with it closely. The peduncles spring from an irregular stolon-like base of a light grey colour, considerably incrusted with sand-grains and shell fragments (Pl. XVIII. fig. 1). The peduncle is always stout, and its length is about three times its average thickness. It widens somewhat as it is traced upwards from the base, and passes gradually into the head at the top. The rosy tint is most marked at the upper end of the peduncle; lower down the colour is greyish. The head is dome-shaped in the largest specimen (Pl. XVIII. fig. 1), and more rounded at the top in the others. There is a common cloacal aperture near the centre of the upper end, and from this lines of Ascidiozooids radiate outwards and downwards to the equatorial region. Consequently each head contains one system only. There are no Ascidiozooids below the equatorial region, the widest part of the head. The Ascidiozooids form about twenty rows, and there are about five in each row; the branchial apertures are very distinct. The surface of the head is smooth. Its colour is rose-red below the equatorial part, passing into dark shades of purple and violet above, and finally becoming almost black at the top around the common cloacal aperture. The margins of that aperture and also of the branchial openings of the Ascidiozooids are marked with a line of opaque white pigment.

The "Porcupine" specimen from Tangier Bay (see Pl. XVIII. fig. 2) is larger than any of the Challenger specimens, and consists of two heads supported by stout branches of a single peduncle. The larger head is 11 mm. in length and 15 mm. in greatest breadth. The branch of the peduncle which bears it is 12 mm. in length and 10 mm. in greatest breadth, while the common basal part of the peduncle is about 20 mm. in length and 6 mm. in average breadth. The general character of this colony agrees fairly with that of the Challenger specimens, the only peculiarity being that the peduncle is here branched. Possibly the common basal part of the peduncle ought to be regarded as corresponding to the stolon in the other specimens. In colour the "Porcupine" specimen agrees well with the description given above. The head is not quite so dark, and shows a good deal of red pigment even above the equatorial line. The upper end has a considerable amount of violet and black pigment. There can be no doubt, I think, that notwithstanding the branched peduncle, the larger size, and the somewhat lighter colour, the colony from Tangier Bay must be referred to the same species as those from the Philippine Islands. It may, however, be regarded as a variety.

The pigmentation of all of these colonies agrees well with that of *Distaplia magnilarva* as described by Della Valle, and differs from that of *Distaplia rosea* where there is no dark colouring, all the pigment being rose-red. From *Distaplia lubrica*, on the other hand, our species is readily distinguished by the entirely different shape of the colony. From the external appearance and colour I should be inclined to refer the Challenger and "Porcupine" specimens to *Distaplia magnilarva*, although in Della Valle's figures[1] the heads are relatively larger and more ovate in shape and the peduncles are very much smaller, but from the small size of the Ascidiozooids and of the tailed larvæ (see below) it is impossible that they can belong to that species. The Ascidiozooids are about 2 mm. in length,[2] and are placed with the long axis extending downwards from the branchial aperture towards the peduncle. The branchial aperture, with its conspicuous white margin, is less than 0·5 mm. in diameter, and the centres of adjacent branchial apertures in the same row are placed about 1 mm. apart (Pl. XVIII. fig. 1). In the "Porcupine" specimen the Ascidiozooids and the branchial apertures are a little larger (Pl. XVIII. fig. 2).

The test is soft and gelatinous in the centre of the colony. The outer layer is firmer, and is very considerably pigmented. The peduncle is the clearest part, but even there small patches of opaque white and dark violet or black pigment are found. The rosy tint of the upper end of the peduncle is due to the posterior ends of some of the Ascidiozooids showing through, and not to red pigment in the test.

In the head this dark pigment is almost entirely confined to the outer firmer layer of the test, the inner part being transparent and of a grey colour. The red and white and black pigmented bodies of the Ascidiozooids show through to a certain extent, and help to make the head, as a whole, more opaque. In the "Porcupine" specimen some parts of the surface layer of test contain a very large amount of red pigment (see Pl. XVIII. fig. 5, *p.c.*), resembling in this respect *Distaplia rosea*.

In its minute structure the test consists of a homogeneous matrix in which are scattered numerous small test cells and larger pigment cells (Pl. XVIII. fig. 4). The test cells are of all shapes, stellate and branched forms being common. The pigment cells are usually ovate or irregularly rounded and very opaque. They show three distinct colours: white, red, and very dark violet or black. The red and the white ones are evenly pigmented all over (Pl. XVIII. fig. 4, *r.p.c.*), while the black ones have the pigment granules usually extending over about one half of the cell, the remainder being clear (Pl. XVIII. fig. 4, *b.p.c.*).

The mantle is fairly strong over the branchial region of the body. On the viscera, however, it is very thin, but is deeply pigmented. The muscle bands are nearly all transverse in direction, and are more regularly placed than in Della Valle's figures of the Ascidiozooids of

[1] Nuove Contribuzioni, &c., Tav. i. figs. 1, 1′, 4 and 4′.

[2] Della Valle gives the length of the Ascidiozooid of *Distaplia magnilarva* as 6 mm.

Distaplia magnilarva. In some specimens of *Distaplia rosea* from the Bay of Naples, which I have examined, the musculature is less marked and less regular than in the new species.

The branchial sac is remarkable on account of the large size of the stigmata (Pl. XVIII. fig. 6, *sg.*). They are long and narrow like those of *Colella pedunculata*, and are arranged with great regularity. Each row is crossed about the middle by a narrow transverse vessel or horizontal membrane (Pl. XVIII. fig. 6, *tr'*) which does not interrupt the stigmata, and is considerably thinner than the regular transverse vessel between the rows. In a specimen of *Distaplia rosea* from Naples,[1] which I have examined, the branchial sac shows precisely the structure which I find in the Challenger species (compare Pl. XVIII. figs. 3 and 6), and differs considerably from the figure given by Della Valle.[2] The latter shows, in the branchial sac, each row consisting of five short stigmata, all of the same size, and not crossed by any horizontal membrane; while I find in all the Ascidiozooids which I have examined of the Naples specimen of *Distaplia rosea*, that there are from twenty to thirty long stigmata in each of the four rows, that those in the middle of the row are the longest, the size decreasing towards each end, and especially towards the ventral end (see Pl. XVIII. fig. 3), and that each row is crossed by a distinct horizontal membrane. The rapid decrease in size of the stigmata as they approach the ventral end of the row allows the transverse vessels to enlarge rapidly into triangular areas which abut against the sides of the endostyle (Pl. XVIII. fig. 3, *tr.*). In other respects the Naples specimen of *Distaplia rosea* agrees well with Della Valle's description and figures of that species.

The dorsal languets are short, triangular, and pointed, and, like those of *Distaplia rosea*, they are not quite in the median dorsal line but slightly to one side. Della Valle states that there are no languets in *Distaplia magnilarva*.

The tentacles of *Distaplia vallii* are rather irregular in size. There are eight rather larger and some intermediate smaller and more irregularly placed ones. The larger tentacles are pigmented.

The alimentary canal is like that of *Distaplia magnilarva* in all essential characters. It is pigmented with opaque white, red, and black patches. The vascular ectodermal appendages are long.

The reproductive organs are hermaphrodite and of large size. They usually consist of one or two large opaque yellow ova and a number of ovate or sausage-shaped testes of a dull brick-red colour. The vas deferens is conspicuous, and is also coloured red.

The tailed larvæ are about 1 mm. in greatest length. They are thus about half the size of those of *Distaplia magnilarva* according to Della Valle. The body is ovate, with the usual three adhering processes in front. The larval tail is short.

On the whole *Distaplia vallii* is closely related to *Distaplia magnilarva* and to

[1] Obtained named from the Zoological Station, Naples.
[2] Nuove Contribuzioni, &c., Tav. i. fig. 9.

Distaplia rosea, and may be regarded as occupying a position between them. In general shape and pigmentation it agrees with *Distaplia magnilarva*, while it differs from that species and agrees with *Distaplia rosea* in having comparatively small Ascidiozooids and larvæ. The peduncle is rather larger than in either of Della Valle's species.

If a *Distaplia* were discovered which was related to *Distaplia magnilarva* and to *Distaplia rosea* in the reverse way to that found in the case of *Distaplia vallii*, that is, if it agreed in shape and colour with *Distaplia rosea* but possessed the large Ascidiozooids and larvæ of *Distaplia magnilarva*, then, unless it had some sufficiently important characters peculiar to itself, it would be necessary to unite the four species, and consider them merely as varieties showing all the possible combinations (AC, AD, BC, BD) of the four characters:—A, large Ascidiozooids and larvæ, B, small Ascidiozooids and larvæ, C, dark pigmentation, and D, red pigmentation. Of course such a combination as AB or CD would be impossible. The formulæ for the three known species would be *Distaplia magnilarva*, AC, *Distaplia rosea*, BD, *Distaplia vallii*, BC, and the imaginary fourth form would be AD.

Genus doubtful.

——————— (?) *clava*, n. sp. (Pl. XXVII. figs. 1, 2).

A specimen found at Station 75,[1] off the Azores, cannot with certainty be referred to its proper position, as it shows no traces of Ascidiozooids. It is an elongated curved mass about 4 cm. in length and 1 cm. in average thickness, and was evidently attached by the lower end. The opposite extremity is slightly swollen and convex, and thus forms a rounded knob on the summit of a thick peduncle (Pl. XXVII. fig. 1), but the entire mass is composed of test.

The surface is rather rough, and the colour is a dark dull grey, having lighter and darker patches on the upper end (Pl. XXVII. fig. 1). It is tough and cartilaginous, and is seen on section to have the same colour and structure all through.

The test matrix appears structureless, but is densely crowded with test cells (Pl. XXVII. fig. 2, *t.c.*). These are rather large, and are mostly of more or less rounded form. They are not granular, but are usually clear, homogeneous, highly refracting, and of a yellow colour. A few fusiform and stellate cells are also present.

In some parts of the test, especially in the knob-like upper end of the specimen, large numbers of pigment corpuscles are found. They are all spherical, ovate, or ellipsoidal in shape, and are of large size (Pl. XXVII. fig. 2, *pig.*). The pigment granules, which are opaque white, are usually confined to one half of the cell. The lighter patches on the upper end of the specimen are due to the presence of very large numbers of these

[1] Station 75, July 2, 1873; lat. 38° 38′ 0″ N., long. 28° 28′ 30″ W.; depth, 450 fathoms; bottom, volcanic mud.

pigment corpuscles. Smaller pigmented cells (Pl. XXVII. fig. 2, *p.c.*) are found scattered here and there through the remainder of the test. Bladder cells are present in some places in abundance (Pl. XXVII. fig. 2, *bl.*). They are large and of the usual ellipsoidal form, and are so numerous in places as to reduce the matrix to a reticulum. In other parts of the test they are rare, and in some entirely absent. The surface layer is always free from bladder cells.

A few delicate vascular appendages are present, running downwards from the knob-like upper end, and terminating in elongated slightly swollen bulbs (Pl. XXVII. fig. 2, *v.ap.* and *t.k.*). The ectoderm cells on these vascular appendages are large and distinct.

There can be no doubt that this specimen belongs to the Ascidiæ Compositæ, although there are no Ascidiozooids present, and on account of its club-like form with the terminal knob (Pl. XXVII. fig. 1) I am convinced that it is entire, and not merely a fragment of a large colony. I believe that when obtained it was probably in a hibernating condition, and that all the Ascidiozooids had died and been ejected from the colony. In this case very probably there were some young buds connected with the vascular appendages, and lying in a dormant condition, from which new Ascidiozooids would have developed later on. Giard has shown that some of the Compound Ascidians of European seas pass into a dormant condition, accompanied by the development of pigment or calcareous spicules, on the approach of winter, and that at such a time all the old Ascidiozooids die and are ejected from the test. The presence of abundance of pigment upon the upper surface of the specimen under consideration favours the view that it was captured when in this hibernating condition.

From the general shape of the colony, and from the presence and appearance of the vascular appendages (Pl. XXVII. fig. 2, *v.ap.*), I am inclined to regard this specimen as belonging to the Distomidæ,[1] and as being probably allied to the genus *Colella*, but in the absence of Ascidiozooids it is impossible to determine even the family with precision. I believe, however, that I can state with certainty, from what is to be made out in the specimen, that it belongs to a species previously unknown.

———— (*?*) *pyriformis*, n. sp. (Pl. XVI. fig. 17).

The Colony is more or less pyriform, but is rather variable in shape. It is attached by the narrower end, which is usually prolonged to form a short peduncle. The upper extremity is broad and rounded. The colony is usually somewhat compressed laterally. No apertures and no systems are visible. The surface is fairly smooth. The colour is a light yellowish-grey, with a tinge of reddish-brown in some places.

The length is 2·3 cm. (including 8 mm. of peduncle), the breadth is 9 mm., and the thickness 4 mm.

[1] In shape it resembles somewhat *Distoma adriaticum*, von Drasche.

The Test is soft but fairly tough. It is of a light grey colour and is semi-transparent. The matrix contains numbers of small test cells, most of which have rounded forms. Bladder cells are present in abundance in all parts of the test. There are no pigment corpuscles.

Locality.—Royal Sound, Kerguelen Island, attached to *Macrocystis pyrifera.*

Ten specimens of this small species were obtained from the fronds of *Macrocystis* at Royal Sound, Kerguelen Island. On account of the absence of Ascidiozooids from all the colonies it is impossible to refer the species with certainty to its proper position, but from the general appearance of the colony there can be little doubt that it is one of the Distomidæ, more or less closely allied to *Colella.*

The colony is always stalked, but the peduncle varies considerably in length. The shape of the body proper varies from almost spherical to a long narrow wedge-like form,[1] but the usual condition appears to be ovate or pyriform (Pl. XVI. fig. 17). There is considerable difference also amongst the specimens in the amount of lateral compression.

In most of the colonies there are no traces of Ascidiozooids, but in one or two small reddish-brown dots are visible placed in vertical rows (Pl. XVI. fig. 17), and recalling the arrangement of the Ascidiozooids in *Colella pedunculata* and *Colella murrayi.* These, however, are merely clumps of cells lying in the test, and are the remains of the missing Ascidiozooids. In one or two places tailed larvæ were found imbedded in the test beside these groups of cells. They seemed to be in a fully developed and healthy condition.

The colonies when collected were probably either in a dying condition and had lost their Ascidiozooids, or they were hibernating and the old members of the colony had been expelled from the test. In the latter case the tailed larvæ which remain may have been destined to develop, after a time, into young Ascidiozooids in the old test, without passing through a free-swimming condition, and so bring the colony back to active life; or possibly they may have been retained in the test as a protection until a more favourable season arrived for being set free before settling down and founding new colonies.

The test in its minute structure is very like that of several species of *Colella* (*e.g.*, *Colella pedunculata*, see p. 78 and Pl. V. fig. 15). The bladder cells are very delicate, but in most places they are abundant. The test cells are small, but very numerous. All shapes are found amongst them, but rounded and ovate forms prevail. In sections of the colony large spaces are found to occur here and there near the periphery. These are evidently the positions which were occupied by the Ascidiozooids. Near the centre of the sections, again, there are smaller openings in the test, which were probably filled formerly by the vascular appendages. In one or two cases the remains of the vascular appendages are to be found, but in most cases, like the Ascidiozooids, they have totally disappeared.

[1] The longest specimen is 3·5 cm. in length.

Cystodytes, von Drasche.

Distoma, Della Valle, Contribuzioni, &c. p. 40, Napoli, 1877. In part.
Distomus, Della Valle, Nuove Contribuzioni, &c., Roma, 1881. In part.
Cystodytes, von Drasche, Die Synascidien der Bucht von Rovigno, p. 18, Wien, 1883 (as a subgenus of *Distoma*).

Colony of irregular form, attached and incrusting, sometimes lobed, and of moderate thickness.

Ascidiozooids surrounded by capsules formed of calcareous disk-shaped spicules. No vascular appendages present.

Test cartilaginous, containing calcareous disk-shaped spicules.

Branchial Sac small.

Abdomen as large as thorax.

Dr. R. von Drasche, in his Synascidien der Bucht von Rovigno, distinguished two new species of Distomidæ as having a remarkable form of calcareous spicule which clearly separated them from all allied forms. On this account he divided the old genus *Distoma*, to which these new forms belong in their other characteristics, into two subgenera, *Cystodytes* and *Distoma*. Previously, however, Della Valle had described and figured[1] a form of spicule occurring in *Distoma dellechiaiæ*, from the Bay of Naples, which is apparently the same as those of *Cystodytes*. In the Challenger collection there are two additional new species which agree in all essential characteristics of generic value with v. Drasche's two species of *Cystodytes* and with *Distoma dellechiaiæ*, Della Valle, and I consider that as these five species are so clearly distinguished from other Distomidæ it will be of advantage and will simplify classification if *Cystodytes* as defined by von Drasche be considered an independent genus.

The colony is in all cases of somewhat irregular form and moderately large size. It is attached by the greater part or the whole of its lower surface, and the upper surface may be either nearly flat or raised so as to form a convex mass of moderate thickness. The species from the Adriatic are of rather greater thickness than those in the Challenger collection: *Cystodytes cretaceus* may be as much as 3 cm. in thickness.

The colour varies considerably. It may be milk-white, grey, yellow, brown, or violet. The surface is always smooth. In von Drasche's two species the Ascidiozooids are arranged in distinct systems. This is not so obvious in the Challenger species. *Cystodytes draschii* shows in some places the formation of irregular systems, but in *Cystodytes philippinensis* there seems to be no definite arrangement. The most characteristic feature of the genus is the formation, around the greater part of the body of each Ascidiozooid, of a calcareous capsule formed of separate discoidal plates which

[1] Nuove Contribuzioni, &c., p. 23, Tav. ix. figs. 98, 99.

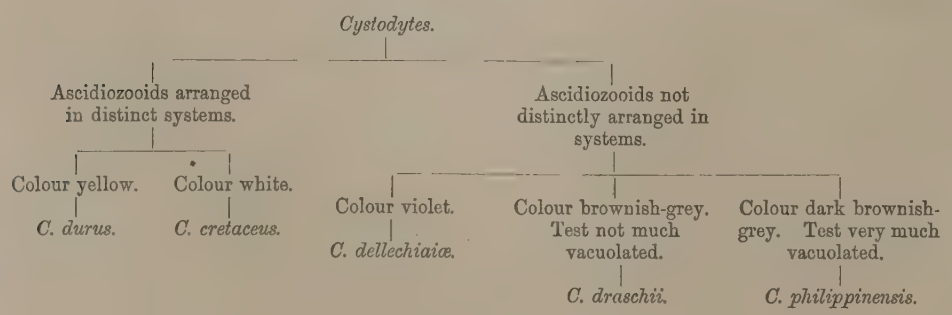
are developed in the test (Pl. XIX. fig. 7). These peculiar spicules are described more fully in the account of the species given below, but they seem very similar in all the five known species, and are quite unlike any other form of spicule found in the Tunicata.

The test is always more or less cartilaginous in consistence, and contains large numbers of bladder cells. The mantle is moderately strong, and the branchial and atrial siphons are both of good size and are six-lobed at their openings. The atrial siphon apparently may vary considerably in form. Von Drasche states that the shape differs in different specimens of *Cystodytes durus*, and the forms I have figured (Pl. XIX. fig. 11, *at.*, and Pl. XX. fig. 7, *at.*) for *Cystodytes draschii* and *Cystodytes philippinensis* are very dissimilar. Common cloacal apertures are always present.

The stigmata in the branchial sac are always of rather small size, and are not very numerous. The tentacles, so far as is known (they are not described by von Drasche), are exceptionally long and numerous. The stomach is always smooth walled. The reproductive organs are hermaphrodite.

The five known species of *Cystodytes*, though agreeing in all the above characters, may, I think, be readily distinguished. In colour they differ considerably. *Cystodytes dellechiaiæ* is violet, *Cystodytes durus* is of a distinct yellow colour, *Cystodytes cretaceus* is milk-white, *Cystodytes draschii* is of a brownish-grey, and *Cystodytes philippinensis* is rather darker than the last. *Cystodytes durus* and *Cystodytes cretaceus* form decidedly thicker colonies than *Cystodytes draschii* and *Cystodytes philippinensis*. *Cystodytes durus* and *Cystodytes cretaceus* have the Ascidiozooids arranged in distinct systems, and, judging from von Drasche's figures, this is especially the case in *Cystodytes durus*, where the systems are obvious and very clearly circumscribed. In the two new species no such distinct arrangement is found, and in *Cystodytes dellechiaiæ*, according to Della Valle, the systems are not well-marked. On the whole the new species are nearer to one another than to any of those previously known, which are very clearly distinguishable by their colours (see von Drasche's beautiful plates). The detailed comparison of the two new species will be given below under *Cystodytes philippinensis*.

The five species may briefly be distinguished by the following characters :—



Cystodytes draschii, n. sp. (Pl. XIX. figs. 1–15).

The Colony is of a rudely elliptical shape, flat, and incrusting, and is of moderate thickness. The colour is of a dull brownish-grey, darker in the centre and more transparent round the edges. The surface is uneven, but smooth and glistening. The common cloacal apertures are inconspicuous.

The length is 6 cm., the breadth is 3 cm., and the average thickness is 5 mm.

The Ascidiozooids are somewhat elongated antero-posteriorly, and are placed nearly always at right angles to the surface. The usual size is 3 mm. antero-posteriorly, and 2 mm. dorso-ventrally and laterally. The anterior end is rather narrow, and terminates in the branchial aperture, while the posterior is broad and rounded. The posterior three-fourths or so of the Ascidiozooid is encased in a capsule formed by disk-shaped calcareous plates closely placed or overlapping. The anterior end projects from this calcareous capsule, and is free and unprotected.

The Test is soft but firm. It is very smooth on the upper surface. It is fairly transparent, especially near the edges. It is of much the same thickness throughout, and the edges are prominent and rounded. The test consists of a clear homogeneous matrix, which is greatly broken up by the presence of numerous large bladder cells, and contains great numbers of smaller cells of various shapes. Near the surface, for a short distance, the test is compact, and contains no bladder cells, but throughout the rest of its extent it is vesiculated. Around the bodies of the Ascidiozooids are formed in the test the discoid spicules which compose the calcareous capsule.

The Mantle is fairly muscular. The muscle fibres are delicate but numerous, and they form a close network. Transverse and longitudinal bands are equally numerous.

The Branchial Sac is small and rather thick walled. The transverse vessels are all of the same size. The stigmata are comparatively small.

The Tentacles are very long and narrow. There are about fifty of them, and they are of two sizes, long and short, placed alternately.

Locality.—Off Barra Grande; depth, 400 fathoms.

A single specimen of this interesting species was obtained off Barra Grande, Brazil, on the 10th September 1873, from a depth of 400 fathoms. It is a flat expanded colony of considerable size (Pl. XIX. fig. 1). The edges are generally thick and rounded, but in some places slightly expanded thin margins are present. The upper surface is nearly flat; here and there, however, it is slightly raised into small rounded knobs and ridges which give an equally distributed unevenness to the whole. This upper surface is very smooth and glistening. The lower surface is rough and rather irregular; it has evidently all served as an adhering area with the exception of a slight margin, which is in some places 5 mm. wide.

The colour on the upper surface varies from yellowish-grey to various shades of brownish-grey. It is lightest on the edges where composed of test only. The bodies of the Ascidiozooids show through indistinctly (Pl. XIX. fig. 1) as opaque light coloured rounded spots.[1] The common cloacal apertures are fairly numerous but not conspicuous. They are irregularly scattered. The under surface of the colony is rather lighter coloured than the upper, but is more opaque-looking, probably on account of the absence of the very transparent glistening superficial layer of test found on the upper surface. The Ascidiozooids are placed nearer to the lower surface, and their white calcareous capsules show through more distinctly than they do on the upper surface.

The Ascidiozooids seem to be to a certain extent arranged in systems of five or six together, but these are by no means regular. Although the branchial apertures are all on the one surface of the colony, and the posterior ends are all placed nearest to the other surface, still the Ascidiozooids are not regularly arranged perpendicularly to the upper surface; consequently, in a vertical section of the colony (such as Pl. XIX. fig. 4), they may be cut at various angles. The shape of the Ascidiozooid is remarkable (Pl. XIX. figs. 4, 5), but it must be remembered that it is mainly due to the presence of the thick calcareous capsule which encloses the posterior end, and which, although it adheres closely to the Ascidiozooid as dissected out from the colony, really belongs to the common test in which it is produced.

The test varies somewhat in structure in the different regions of the colony. Figure 2 shows a section extending from the outside (on one of the margins) for a considerable distance inwards. The outer layer is seen to be free from bladder cells, and to have scattered in the matrix merely the ordinary rounded fusiform and stellate cells. These are comparatively large and numerous. Then as the section is traced inwards, bladder cells make their appearance and rapidly become very abundant,—even more abundant in some places than appears from the figure. They are large, spherical or ellipsoidal in shape, and have distinct nuclei adhering to one part of the wall. In the narrow bars of test matrix left between these bladder cells, the small fusiform and stellate cells are still found. This is the region of the test where the bladder cells are most abundant. Further in towards the centre of the colony they become less numerous, although they are always fairly abundant. The small test cells continue to be thickly scattered in all parts of the colony (Pl. XIX. figs. 2, 3, *t. c.*).

In the deeper parts of the test, away from the margins, are found groups of rounded cells with very large distinct nuclei (Pl. XIX. fig. 2, *t. c.'*), and occasionally a small calcareous spicule may be found in the centre of such a clump. These indicate the mode of origin of the remarkable calcareous capsules enclosing the Ascidiozooids. The small fusiform or branched test cells may apparently in this genus either develop into large bladder cells,

[1] The upper surface of the single specimen presents rather a curious appearance in some parts from small air-bubbles having gained access to spaces (the cloacal cavities) under the surface layer of test.

or they may proliferate, in the neighbourhood of the Ascidiozooids, to form the groups of closely-placed cells with large nuclei. These cells then deposit between them a calcareous spicule, around which they are, when it is completed, stretched in the form of a thin membranous capsule containing nuclei. Such a capsule may be readily stained in the case of most of the large discoid spicules, and is sometimes seen hanging loosely from fragments of broken spicules. The nuclei are very like those of the rounded cells in figure 8, and intermediate conditions may be found covering the smaller spicules.

The calcareous capsule around the Ascidiozooid is formed of a large number of circular disks placed vertically in the layer of test immediately surrounding it (Pl. XIX. fig. 3, *sp.*). The disks are in most parts so numerous as to overlap one another's edges (Pl. XIX. fig. 7), and are on an average 0·4 mm. in diameter. Each disk is thickest in the centre, and tapers towards the circumference. This, as well as the general arrangement, may be seen from the transverse section of an Ascidiozooid and the neighbouring part of the common test shown in figure 3. It is also seen that the capsule is by no means a regular uniform covering, but is thick in some places (where it may be five or six spicules deep), and thin or absent in others. Some of the disks are not perfectly flat, but are slightly curved, as seen in section, and are placed with the concavity towards the body of the Ascidiozooid. In the cases of a few of the spicules in the figure (Pl. XIX. fig. 3, *sp.*), the capsule is seen to fit very loosely, leaving a large open space between itself and the enclosed spicule. Whether this is natural, or a result of the method of preservation and after-treatment, it is difficult to say. The disks, when seen in surface view as in figures 6 and 7, are beautifully marked by delicate concentric bands and by radiating lines. The latter in many cases go in groups, being absent or more openly placed in particular regions of the spicule, and closer in others (Pl. XIX. fig 6).

The mantle is of considerable strength. The musculature over the greater part of it is in the form of a close network formed by strong bundles of longitudinal and transverse bands running at right angles, and forming narrow quadrangular meshes (Pl. XIX. fig. 9). When these muscle bands reach the anterior end they become the radiating and circular bundles which surround the branchial aperture in a somewhat irregular manner (Pl. XIX. figs. 10, 11). The branchial sphincter is well developed and compact. Beyond it for a short distance the radiating muscle fibres are not collected into bundles, but form an evenly distributed layer which passes outwards, crossing several series of circular fibres. Further out, however, the radiating fibres become grouped together into definite bundles separated by clear spaces free from muscle fibres (Pl. XIX. fig. 10), and these bundles are continued down the sides of the body, as the longitudinal bands of the network shown in figure 9. The muscular fibres throughout the greater part of the mantle are very narrow, but in some places fibres of considerable size, up to 0·004 mm. in breadth, are met with. There are many variously shaped connective tissue cells with very large distinct nuclei scattered through the mantle (Pl. XIX. fig. 10).

The branchial aperture is distinctly six-lobed, and the whole branchial siphon is considerably pigmented of a reddish-brown colour (Pl. XIX. fig. 10). The atrial aperture is prolonged into a long narrow siphon which opens into the common cloacal cavity (Pl. XIX. fig. 11, *at.*).

The branchial sac is thick and opaque. The stigmata are small and not very numerous. The endostyle is large and has a serpentine course (Pl. XIX. fig. 3, *en.*).

The tentacles are very numerous, remarkably so for a Compound Ascidian, and are also, some of them, singularly long and narrow. Their bases are closely placed (Pl. XIX. fig. 12). They have all the appearance of being extensile and retractile, as some portions of them have a stretched out appearance (Pl. XIX. figs. 12, 13). Some of the epithelial cells on the surface of the tentacles are large and fusiform, with very large central ovate projecting nuclei. These cells are placed generally in little groups, with their long axes pointing along the tentacle. On the edges of the tentacle, as seen under a high magnification (about 1000 diameters), the nuclei form rounded projections of considerable size (Pl. XIX. fig. 13). At the extreme tip of the tentacle these cells are much more numerous, and cover almost the whole surface, the nuclear projections giving it quite a rough knobbed appearance (Pl. XIX. fig. 14).

The alimentary canal occupies the broad rounded posterior end of the Ascidiozooid. The stomach is large and globular, and is smooth on the outer surface. The intestine is short. A few tailed larvæ were found in the colony; the single pigmented sense organ is placed near the posterior end of the body, the endostyle is large, and they are in many ways very like those of *Colella pulchra* (compare Pl. XIX. fig. 15, and Pl. XV. fig. 12).

Cystodytes philippinensis, n. sp. (Pl. XX. figs. 1–12).

The Colony is of irregular form, flat and incrusting, and of moderate thickness. The colour is dark brownish-grey, rather lighter round the edges. The surface is uneven but fairly smooth. The common cloacal apertures are inconspicuous.

The length is 4 cm., the greatest breadth is 3 cm., and the thickness about 5 mm.

The Ascidiozooids are elongated antero-posteriorly, and are usually placed at right angles to the surface. The usual size is 2·5 mm. antero-posteriorly, and slightly more than 1 mm. in greatest breadth. The anterior end is slightly narrower, and terminates in the branchial siphon, while the atrial projects from its dorsal extremity. The posterior end of the body is broad and rounded. The posterior half or three-fourths of the Ascidiozooid is concealed by a calcareous capsule formed of disk-shaped spicules. The anterior end projects from this capsule and is quite unprotected.

The Test is firm and rather stiff. It is smooth on the upper surface, and is moderately transparent. It does not vary much in thickness, and the edges are prominent and rounded. The matrix is clear and homogeneous, but it is greatly reduced and

broken up by the presence of innumerable bladder cells which in most places are so abundant as to become polygonal by mutual pressure, and reduce the matrix to a system of mere bands and membranes separating the cavities from one another. The usual small variously shaped cells are abundant all through the test. In the neighbourhood of the Ascidiozooids are found the large discoid spicules which form the calcareous covering.

The Mantle is strong and has a well-developed musculature. The muscle fibres are large and numerous, and form a close network. They run in all directions.

The Branchial Sac is small and thick walled. The transverse vessels are wide and all of one size. The stigmata are rather small. The fine longitudinal vessels are narrower than the stigmata.

The Tentacles are numerous and rather long.

Locality.—Samboangan; depth, 10 fathoms.

Of this species of *Cystodytes* three small colonies were obtained off Samboangan in the Philippine Islands, from a depth of 10 fathoms. It is closely allied to the last described species, but they differ in a number of details which are pointed out below.

Like *Cystodytes draschii* this is a flat or nearly flat expanded incrusting colony, which is probably attached to foreign objects by the greater part of its lower surface. It is of quite irregular shape (Pl. XX. figs. 1, 2), and grows out into rounded lobes. The margin is thick and projecting as in the last species, but it is more irregular and not so transparent. A slight expanded thin margin is present at one or two points. The upper surface is undulating, and has besides numerous very slight elevations which correspond to the anterior ends of the Ascidiozooids. It is smooth and somewhat glistening, but not so much so as in the case of *Cystodytes draschii*. The lower surface (Pl. XX. fig. 2), on the contrary, is not so rough as in the previous species. It is, however, very irregular, and has various foreign bodies—sand-grains, shell fragments, and Polyzoa—adhering to it. There is a slight rounded margin, varying from 2 mm. to 5 mm. in thickness, round the greater part of the edge (Pl. XX. fig. 2), which evidently did not adhere.

The colour is distinctly duller and darker than in *Cystodytes draschii*, and has none of the yellowish tinge found in that species, otherwise it is similar. The Ascidiozooids show through in the same indistinct manner (Pl. XX. figs. 1, 2), but form smaller light-coloured areas than in the previous species. The under surface is scarcely at all lighter in colour than the upper, and the Ascidiozooids do not show through so distinctly on this surface. In short the Ascidiozooids altogether are rather less conspicuous in this species than in the last.

In a section the Ascidiozooids are seen to be mostly placed vertically in the colony (Pl. XX. fig. 3); some, however, are inclined. No arrangement in systems can be distinctly made out. The general shape of the Ascidiozooid and its relation to the surrounding calcareous capsule (Pl. XX. figs. 3, 5) is the same as in *Cystodytes draschii*.

The branchial siphon is small and is placed at the anterior end of the body. The atrial siphon is rather on the dorsal edge. It is large (Pl. XX. fig. 7, *at.*), but is shorter and rounder than that of *Cystodytes draschii*.

The test, although its general structure is the same as in the last species, is considerably more vacuolated (see Pl. XX. figs. 5, 6, 9, 12). This is due to the very great abundance of the bladder cells. The superficial layer of the colony has none (Pl. XX. fig. 6), but all the rest of the test is occupied by them to such an extent that the matrix is almost entirely absent (Pl. XX. fig. 9). All that is left is the system of membranes and delicate trabeculæ which bound the large polygonal bladder cells. In these trabeculæ lie the small fusiform test cells (Pl. XX. fig. 6, *t.c.*), and along their edges are placed the parietal nuclei of the large bladder cells. Under a low power (50 diameters) a section of the test shows generally several adjacent layers of the polygonal cells intersecting one another so as to form an irregular meshwork (Pl. XX. fig. 9), while the whole is thickly peppered over with minute dots, the nuclei of the cells. A higher magnification (Pl. XX. fig. 6) shows the individual bladder cells more clearly, and allows their nuclei to be distinguished from those of the unmodified test cells in the reduced matrix. This whole structure is singularly like that of the test of *Colella pedunculata* (see p. 78), as may be seen by comparing Plate XX. figure 6 with Plate V. figures 14, 15. It is clearly an extreme form of the modification commenced in the test of *Cystodytes draschii*, and seen, though to a much less extent, in one part of figure 2 on Plate XIX. Groups of rounded cells with large nuclei are present in the neighbourhood of the Ascidiozooids (Pl. XX. fig. 5).

The calcareous capsule enclosing the Ascidiozooid, as in the case of the last species, really belongs to the neighbouring part of the colonial test (Pl. XX. fig. 5). It consists of a number of large discoid calcareous plates which lie vertically and are somewhat irregular in distribution, being in some places more numerous than they are in others. These disks are rather larger than in the last species, being on an average 0·5 mm. in diameter. They are also very much thicker, as a comparison of Plate XX. figures 4, *B*, and 5, and Plate XIX. figure 3, showing the edges of both, will show. Otherwise the shape in the two species is the same. In surface view, however, the spicule in the present species seems, doubtless on account of its greater thickness, much stronger and more opaque (Pl. XX. fig. 4, *A*). The minute markings on the spicule and the method of its formation seem to be much the same in both cases.

The superficial layer of the test seems not to adhere[1] to the anterior portions of the Ascidiozooids, and can readily be torn off from the colony. It then, when slightly magnified, presents the appearance shown in Plate XX. figure 10. The branchial apertures (*br.*) are distinct rounded apertures. They are usually not quite circular, but have a

[1] It must be remembered that the specimens I examined had all been preserved in alcohol. Doubtless when living the mantle and test adhere throughout.

more or less well-marked pentagonal or hexagonal (usually the latter) form. The test for a short distance around the branchial aperture is very thin and transparent, and thus a circular light coloured area around the aperture is produced (Pl. XX. fig. 10). I regard this (the region between *br.* and *br.si* in fig. 10) as the thin layer of test which turns in at the branchial aperture and lines the branchial siphon. So that, according to this view, although *br.* is the actual aperture in the test through which water, &c., enters the branchial sac, *br.si* indicates the apparent edge of the branchial aperture on the outside of the body. The diagrammatic vertical section given in Plate XX. figure 11 shows this more clearly. The remainder of the surface layer of test, although still thin, is a good deal thicker and less transparent than the part lining the siphon. The area occupied by each Ascidiozooid is clearly marked out and separated from the neighbouring areas by a projecting ridge with a broken top, forming an irregularly hexagonal figure (Pl. XX. figs. 10, 11. *t.*). This is simply the test matrix left between the various Ascidiozooids (Pl. XX. fig. 12, *t.*), and it is merely this comparatively narrow ridge which is torn across in removing the superficial layer of test. It tears along the dotted line in the diagrammatic section (Pl. XX. fig. 11, *t.*). Lower down this ridge expands (Pl. XX. fig. 12) into the general test mass of the lower part of the colony in which the calcareous spicules are formed. The large cavities enclosed by the ridges projecting inwards from the surface contain the anterior parts of the Ascidiozooids. In the alcoholic specimens these latter have contracted greatly, and as a result of this in most cases the branchial siphon has been drawn downwards towards the posterior or lower part of the cavity, allowing a free passage from the outside into the cavity in the test. This is shown by the arrow in the middle of the diagrammatic figure (Pl. XX. fig. 11). If the specimens are taken out of the alcohol for a few minutes small air-bubbles enter in this manner and give a very remarkable appearance to the upper surface of the colony.

The mantle is thick and strong. The muscle fibres are in most parts both numerous and of large size ; they form a close network (Pl. XX. fig. 7). Longitudinal and transverse bands are equally well developed. The sphincters are not specially powerful.

The transverse vessels of the branchial sac are nearly as wide as the stigmata are long (Pl. XX. fig. 8). The stigmata though short are regularly arranged.

The tentacles are very numerous, their bases touch. They are many of them long, but not so narrow as in the last species. Various sizes are seen, but there appears to be no regular arrangement.

The colony as a whole is stiffer and more brittle than in *Cystodytes draschii*. This is, I believe, due to the stronger calcareous spicules and to the extreme vacuolation of the test. The calcareous investments of the Ascidiozooids are also whiter and more conspicuous than in the case of the last species.

Symplegma,[1] n. gen.

Colony formed of several ovate heads connected by branched peduncles.

Ascidiozooids moderately large, not much elongated, and not divided into regions.

Test firm, vessels numerous.

Branchial Sac large and well developed, provided with internal longitudinal bars.

Dorsal Lamina in the form of a plain membrane.

Alimentary and Reproductive Organs forming a mass projecting for a short distance behind the branchial sac.

This genus is formed for a very remarkable species, which, while belonging probably to the Distomidæ, shows certain characters which are not found elsewhere in that family, and on the other hand are characteristic of the Botryllidæ. These are the highly vascular test (see Pl. XVIII. figs. 8, 9), the presence of internal longitudinal bars in the branchial sac (Pl. XVIII. figs. 10, 12), the absence of languets on the dorsal lamina (Pl. XVIII. fig. 13), and the want of a well-marked abdomen. In general appearance and structure the colony is a *Colella* (see Pl. XVIII. fig. 7), and looks not unlike *Colella concreta* and *Colella ramulosa*, but the above mentioned characters—especially the structure of the branchial sac and of the dorsal lamina—are so remarkable and important that it is necessary to form a new genus. There is only one colony in the collection. It was obtained in shallow water off Bermuda.

Symplegma viride, n. sp. (Pl. XVIII. figs. 7–14).

The Colony is composed of ovate or elongated masses connected by branched peduncles. The head varies greatly in form, but is always narrow at its lower end, where it tapers gradually into the top of the peduncle. The colour of the head is a dull green with spots of reddish-brown scattered here and there. The peduncle is of a dull greyish-yellow colour. The surface is uneven and not smooth.

The length of the head is 1·2 cm., the greatest thickness is 0·7 cm., the length of the peduncle is about 1·5 cm., and its thickness 0·3 cm.

The Ascidiozooids are fairly large, and are so numerous as to occupy nearly the whole surface of the head. They show as ovate projections about 2 mm. in greatest length. They are not much elongated antero-posteriorly, and are not placed at right angles to the surface, but incline from the anterior end downwards and inwards towards the top of the peduncle.

The Test is small in quantity. It is rather hard and firm, and is not transparent. It is of a dull green colour. The matrix is firm and homogeneous, but is penetrated by

[1] σύμπλεγμα.

vessels of considerable size, with swollen end-bulbs filled with blood-corpuscles. The cells in the matrix are very few in number, and of small size.

The Mantle is strong. The muscle bands are not large, but they are very numerous and run in all directions, forming a close but very irregular network. The blood-corpuscles are of a dark green colour, and give the mantle a very decided tint.

The Branchial Sac is large, and has a number of stigmata. Internal longitudinal bars are present, and they divide the inner surface into meshes. The transverse vessels are all exceedingly narrow. The stigmata are large and regularly arranged; they are about equal in width to the fine longitudinal vessels between them.

The Tentacles are of moderate size, and are all of the same length. They are eight in number.

The Dorsal Lamina is a plain narrow membrane with no ribs nor teeth.

The Dorsal Tubercle is a small circular aperture placed in a deep triangular peri-tubercular area.

The Alimentary Canal is small, and does not extend far behind the branchial sac.

The Reproductive Organs are placed alongside the alimentary canal.

Locality.—Off Bermuda; shallow-water.

This is an interesting and important form on account of the resemblances it shows to the Botryllidæ on the one hand and to the Distomidæ on the other. It is possible that when its structure has been more minutely examined in better preserved and more abundant material it may prove to be more closely allied to the Botryllidæ than it is to the Distomidæ. A single specimen only is present in the collection. It was obtained off Bermuda, in shallow water. It consists of about ten heads connected by narrow branched peduncles, and closely united to a group of Sponges, Polyzoa, and other foreign objects, the whole forming a tree-like mass about 10 cm. in height and 2·5 cm. in greatest breadth (Pl. XVIII. fig. 7). Unfortunately the specimen is in bad condition and is evidently very much shrivelled and distorted, consequently it is impossible to get a correct idea of the external appearance.

The heads vary greatly both in size and shape. The largest is almost 2 cm. in length, but is rather narrow; others are short and broad. The dimensions in the above description are taken from a medium sized head. The top is usually wider than the base, and is more or less rounded. The sides are not flattened. The lower end of the head tapers downwards to the peduncle, which is relatively narrow (Pl. XVIII. fig. 7). The surface of the head is rendered very uneven by the shrivelling of the test between the Ascidiozooids. The colour of the colony is peculiar. The head is a dull sage green with a few reddish-brown, or, in some cases, dull orange markings. The peduncle is usually a sort of buff or dull yellowish-grey colour.

The Ascidiozooids are numerous and closely placed. They form little rounded projections all over the surface of the head, but probably were not so prominent when in a living condition. The orange marks present in some places are caused by the alimentary viscera showing through; usually they are not visible. In most of the Ascidiozooids the branchial aperture can be made out as a small light-coloured dot. The rest of the body of the Ascidiozooid is dark green. It lies obliquely in the test, its posterior end pointing downwards to the base of the colony as well as sloping inwards a little towards the centre of the head. The viscera are placed close behind the branchial sac, so there is not much antero-posterior elongation in the body. Most of the branchial part shows at the surface, and varies in length from 1 mm. to 2 mm. Some young Ascidiozooids of small size are present in the colony.

The test is remarkable on account of its very limited amount, its toughness, its comparative want of cell elements, and its well developed system of blood-vessels (Pl. XVIII. fig. 8). Between the Ascidiozooids there is merely a thin layer of test, and there is not much more present in the centre of the head. This is probably due to a great extent to the shrunken condition of the colony. Most of the heads are flattened laterally, but I am of opinion that this is not the natural shape, but is due to distortion during the process of preservation. Possibly the strength and firmness of the test is also unnatural. The matrix is apparently structureless, and contains very few cells. The blood-vessels are numerous and large. They branch freely (Pl. XVIII. figs. 8, 9) and have swollen terminations. In some places near the surface they are found to form by branching and anastomosing systems of small meshes, from which are given off numbers of swollen bulbs on the side next the surface (Pl. XVIII. fig. 9). Nearly all the vessels contain large quantities of blood-corpuscles, most of which are of a green colour. The terminal knobs are, as a general rule, not greatly swollen (Pl. XVIII. fig. 8, *t.k.*), being more of a club-shape than the ovate form found in many other Ascidians.

The mantle has a peculiar form of musculature. The bands are thin, and in some places very delicate, but they are exceedingly numerous, and form a close reticulation. On both siphons the sphincters are very strong, and numbers of muscle bands radiate from under them over the neighbouring parts of the mantle, forming with the other irregularly running bundles of fibres a very close network. There is a good deal of pigmentation in the mantle, the lacunæ being in many places filled with dark green blood-corpuscles.

The branchial sac is large and well developed. It is very like the sac of some of the Botryllidæ, and it has internal longitudinal bars. These are rather broad but very thin membranes, which are not placed at regular distances, and apparently vary in number. In a very young sac (Pl. XVIII. fig. 12) three bars (the usual number in the Botryllidæ) were found upon one side, but in some of the adult branchial sacs (Pl. XVIII. fig. 10) only two bars were present upon each side.

The meshes are irregular in size and shape, on an average each contains about four

stigmata (Pl. XVIII. figs. 10, 12). The transverse vessels vary a little in size, but are always very narrow. In some cases they are so small as to be reduced to an undulating vessel winding between the ends of the adjacent interstigmatic vessels (Pl. XVIII. fig. 11, *tr.*).

The stigmata are rather long and narrow in the fully developed sac (Pl. XVIII. fig. 10, *sg.*). In the young state they are short and rounded (Pl. XVIII. fig. 12, *sg.*), and all intermediate forms may be found. In some places the branchial sac is of an opaque green colour from the numbers of blood-corpuscles contained in the vessels. The endostyle is long and narrow, and takes a straight course. It is not very conspicuous.

The dorsal lamina is remarkable on account of its having no languets. It is a perfectly plain and rather narrow membrane (Pl. XVIII. fig. 13, *d.l.*), which is formed anteriorly by the junction of the right and left halves of the peripharyngeal band (Pl. XVIII. fig. 13, *p.p.*). The dorsal lamina is exactly like the internal longitudinal bars of the branchial sac, but is a good deal wider.

The tentacles are like those of some species of *Colella*. They are not numerous, and are all of one size. They are attached to a very thick muscular band which encircles the base of the branchial siphon, and bounds the prebranchial zone anteriorly (Pl. XVIII. fig. 13, *sph.*), while it forms the posterior end of the branchial sphincter.

The aperture of the dorsal tubercle is small, but has a thick lip surrounding it. It is placed nearly at the angle of a very deep triangular peritubercular area (Pl. XVIII. fig. 13, *d.t.*), which is formed by the peripharyngeal bands bending posteriorly to join the anterior end of the dorsal lamina.

The alimentary and reproductive viscera form an opaque yellowish mass placed alongside the posterior part of the branchial sac and projecting very little beyond it. The œsophagus is narrow. The stomach (Pl. XVIII. fig. 14, *st.*) is large and globular. It lies with its long axis directed dorso-ventrally. It is ridged internally and has a small curved horn-like cæcum (Pl. XVIII. fig. 14, *cæ.*) projecting from the anterior part of its ventral end. The intestine is wide. It curves ventrally and anteriorly, and then after running for a short distance dorsally it crosses the œsophagus, and turning anteriorly again becomes the rectum, which runs up the dorsal edge of the branchial sac to open into the peribranchial cavity near to the atrial aperture.

In structure and course, as well as in position, the alimentary canal resembles that of some of the Botryllidæ. The reproductive organs are hermaphrodite, and consist of one or two large clear yellow ova and an irregular mass of small spermatic vesicles.

A number of tailed larvæ were found in the colony. They are rather small, and have short rounded bodies. Two pigmented sense organs are present.

Family III. Polyclinidæ.

Colony usually massive; sometimes incrusting, sometimes lobed, or even pedunculated.

Systems of various shapes, sometimes very irregular or absent. Common cloacal apertures usually inconspicuous.

Ascidiozooids always elongated antero-posteriorly, and usually divided into three distinct regions.

Test gelatinous or cartilaginous, sometimes rendered stiff by imbedded sand-grains.

Branchial Sac usually small, and not highly developed. Stigmata usually small.

Dorsal Lamina represented by a series of languets.

Tentacles generally small and not numerous.

Alimentary Canal extending considerably beyond the branchial sac posteriorly.

Reproductive Organs placed behind the intestinal loop. Testis represented by a number of small spermatic vesicles attached to a large vas deferens.

Gemmation from the post-abdomen.

This large family, including an immense number of species, was founded by Giard in 1872. It includes five of Savigny's genera, viz., *Aplidium*, *Polyclinum*, *Sidnyum*, *Synoicum*, and *Sigillina*, all of which may still be retained either as genera or subgenera. Milne-Edwards in 1841 recognised that these forms, to which he added a sixth, *Amaroucium*, composed a natural group characterised by the shape of the Ascidiozooid. They constitute his 1re tribu, Polycliniens, which is practically, after the removal of the genus *Sigillina*, Giard's family Polyclinidæ. Milne-Edwards' *Amaroucium* is probably, as Giard suggests, the same as Savigny's *Aplidium*, Milne-Edwards having had the advantage of working at living material discovered the common cloacal apertures which Savigny who examined preserved specimens only had regarded as being absent.

Alder in 1863 employed the genus *Parascidia* (which had been previously suggested by Milne-Edwards) for the reception of three species resembling *Sidnyum* in all points except that they have an eight-lobed in place of a six-lobed branchial aperture. This genus has not been recognised or discussed by any subsequent writer. Its relations to *Circinalium* and *Fragarium*, afterwards founded by Giard (see below), must be very intimate.

Giard in 1872 formally raised the Polyclinidæ to the rank of a family, from which, however, he excluded *Sigillina*, a retrograde step, since that genus is certainly more nearly allied to *Polyclinum* than to any of the Distomidæ. Giard added a number of new species to the family, and established as new genera or subgenera *Fragarium*, *Circinalium*, and *Morchellium*. His classification of the family appears to be as follows:—

	Genus.	Subgenus.
Polyclinidæ, ...	*Aplidium.*	*Aplidium.* *Amaroucium.* *Fragarium.* *Circinalium.* *Morchellium.* *Sidnyum* (?).
	Polyclinum.	*Polyclinum.* *Aurantium.* *Sidnyum* (?).

It is not very clear whether he regards *Sidnyum* as coming under the genus *Aplidium* or the genus *Polyclinum*, and he does not state where he places *Synoicum*.

Von Drasche, writing in 1883, virtually endorses Giard's classification. He accepts the two main generic types *Aplidium* and *Polyclinum*, places *Sidnyum*, *Synoicum*, and *Sigillina* as subgenera under *Aplidium*, and recognises no subdivision in *Polyclinum*. The restoration of *Sigillina* to the Polyclinidæ constituted, however, a distinct advance upon Giard's scheme. Later on in the same year von Drasche[1] founded a new subgenus of *Aplidium*, *Polyclinoides*, for a species from Mauritius. The affinities of this form will be discussed further on.

Verrill's *Macroclinum*[2] seems not to be sufficiently distinct to require a separate genus. It contains a single species, *Macroclinum crater*, Verrill, from the Banks of Newfoundland. More information in regard to this form is required before it can be referred with certainty to its proper position.

The shape of the colony in this family is exceedingly varied. It is usually irregular and massive, and is frequently lobed on the upper surface. In some cases (*e.g.*, *Pharyngodictyon mirabile*, Pl. XXI. figs. 1, 2, 3) the lower part of the colony next to the point of attachment becomes prolonged to form a peduncle; while in others (*e.g.*, *Psammaplidium effrenatum*) the colony becomes flattened and forms a thin incrusting layer. It is comparatively rare amongst the Polyclinidæ to find the systems conspicuous and distinctly circumscribed as they are in the Botryllidæ. In most cases they are so irregular that it is impossible to make out their limits in specimens preserved in alcohol, and very generally the common cloacal apertures if present are not visible. It was this circumstance which led to the establishment of *Amaroucium* as a generic name (see under *Amaroucium*, below).

The Ascidiozooids of the Polyclinidæ are very characteristic. They are usually of large size, and are greatly elongated antero-posteriorly. The intestinal loop extends for a considerable distance behind the branchial sac, forming the region distinguished by Milne-Edwards as "abdomen," but the length of the body is in most cases mainly due to the long "post-abdomen," which extends behind the intestinal loop and contains the

[1] Ueber eine neue Synascidie, *Verhandl. d. k. k. zool.-bot. Gesellsch. Wien*, Bd. xxxiii. p. 119.

[2] *Amer. Journ. Sci. and Arts*, 3rd series, vol. i. No. 4, p. 288, 1871.

reproductive organs and the heart (see fig. 3 on p. 16). The length of the post-abdomen is very variable (compare Pl. XXVIII. fig. 2 with Pl. XXX fig. 13), and as pieces may become detached from its end in the form of buds, it is obvious that the size may vary not only in different Ascidiozooids of the same colony, but even in the same Ascidiozooid at different times. The post-abdomen is composed of an outer layer of ectoderm covering a narrow sac-like prolongation of the connective tissue and muscle bands of the mantle. This sac contains a mass of mesoderm cells, and is divided into two parts by a double median partition or septum (Pl. XXIX. fig. 11), which, according to Kowalevsky,[1] is a prolongation of the posterior end of the branchial sac.

The test varies greatly in its texture. It may be soft and gelatinous as in *Polyclinum molle*, firm and cartilaginous as in *Atopogaster gigantea*, or tough and leathery as in *Amaroucium albidum*. In some cases, when it would otherwise be soft, its appearance and character are totally changed by the numerous sand-grains and other foreign bodies attached to its surface and even imbedded in its interior. A number of the new forms discovered during the Challenger Expedition have the test in this curious condition (see Pl. XXXI. fig. 9). They form the genus *Psammaplidium*.

The mantle is well developed, and the musculature is usually of moderate strength. There is great variability in the arrangement of the muscle bands. In some cases they are all longitudinal in direction, while in others the chief bands run circularly around the thorax. In the post-abdomen they are always longitudinal. The branchial aperture is usually very distinctly six-lobed (Pl. XXXI. fig. 3), rarely eight-lobed (*Morchellioides affinis*, Pl. XXIV. fig. 19) or nearly circular (*Aplidium fuscum*, Pl. XXVIII. fig. 10). The atrial aperture may be six-lobed, but is more usually circular, or provided with a single large lobe placed on its anterior edge and known as the atrial languet (Pl. XXIX. fig. 10, *at.l.*). This languet may be placed considerably in front of the atrial aperture (as in von Drasche's *Polyclinoides diaphanum*, see also Pl. XXXI. fig. 3), and in that case the margin of the aperture is circular and unlobed. There is seldom any well-marked atrial siphon.

The division of the Polyclinidæ into genera is an exceedingly difficult matter. Previous to the publication of von Drasche's short note on *Polyclinoides diaphanum*, in 1883, the family seemed to fall naturally into two groups which have been recognised by most authors as the genera *Aplidium* and *Polyclinum*, but the subgenus *Polyclinoides*, proposed by von Drasche, unites the characters of *Aplidium* and *Polyclinum* in a way which renders it practically impossible to say to which group it really belongs. Von Drasche assigns it to *Aplidium*, but he might, I think, with equal propriety have placed it under the genus *Polyclinum*. Some of the new species described in the following pages also exhibit the same intermediate characters between the two groups, and render their recognition in the wider sense in which they are employed by Giard and von Drasche no

[1] Ueber die Knospung der Ascidien, *Archiv. f. mikrosk. Anat.*, Bd. x. p. 441, 1874.

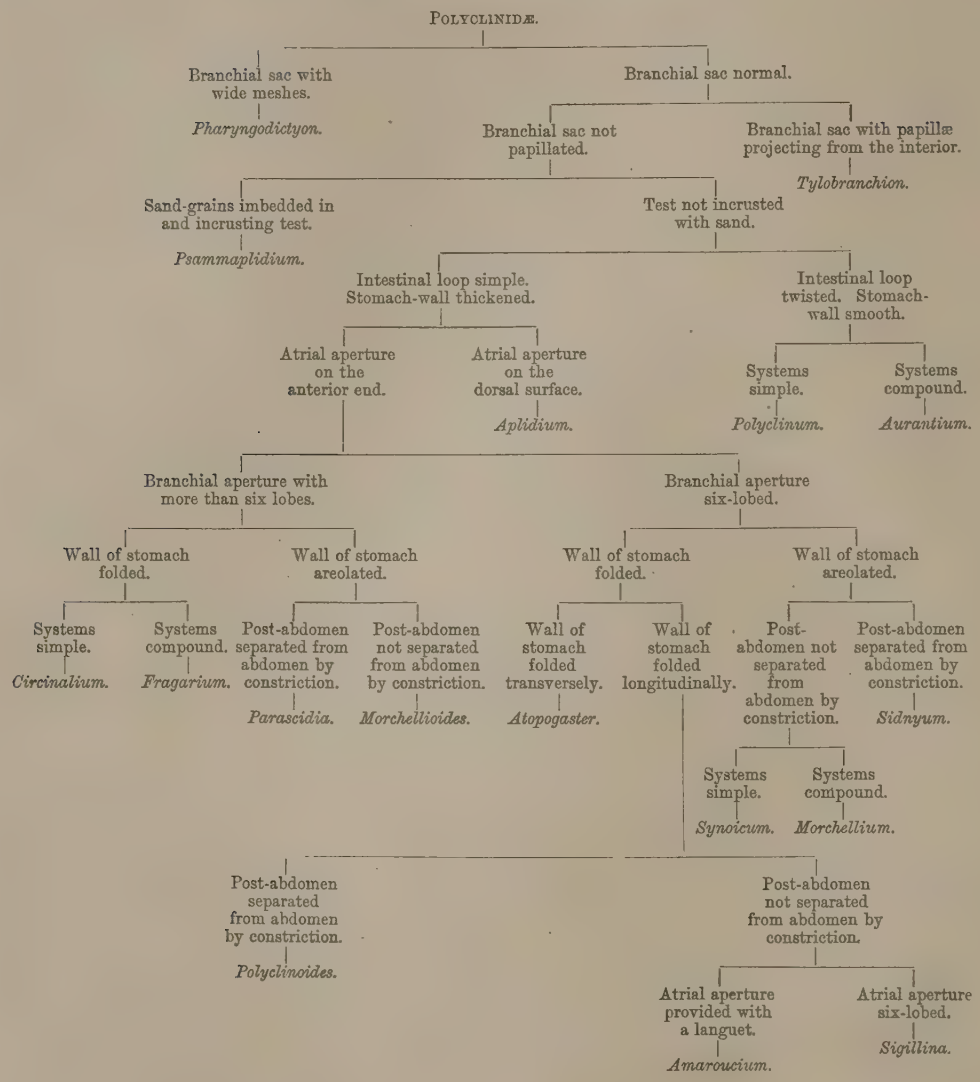
longer possible. Consequently, I feel compelled to arrange the large number of species composing the family in a series of closely allied groups which may be considered either as genera or as subgenera, and which are in some cases not very clearly separated from one another. The Polyclinidæ exhibit peculiarly well the difficulties in classifying which are the natural result of the origin of species by evolution: most of the groups pass gradually into one another, and strict lines of demarcation are almost always absent.

The subgenera proposed by Giard and by von Drasche have been retained, and along with the older genera of Savigny, Milne-Edwards, and others, and the new groups rendered necessary by some of the Challenger specimens, constitute the sets of species represented by the names in the Table below, and treated, for the sake of convenience, as genera in the following pages. In the Table (p. 152) the relative positions of the names do not always indicate the degree of affinity, and the distinguishing characters of the groups are stated in the briefest possible manner. The detailed characteristics and the genetic relationships are discussed under the head of each genus further on. I have avoided making use of the relative length of the post-abdomen as a distinguishing feature, as I am convinced that in some forms at least it is liable to very great variability, and even differs in size at different times in the life of the same Ascidiozooid.

Three of the groups in the Table—*Sigillina*, *Synoicum*, and *Sidnyum*—are Savigny's genera unchanged. Two of them—*Aplidium* and *Polyclinum*—are genera founded by Savigny, but now used in a more restricted sense. Four—*Aurantium*, *Circinalium*, *Fragarium*, and *Morchellium*—were subgenera proposed by Giard. *Amaroucium* and *Parascidia* were established by Milne-Edwards, and *Polyclinoides* by von Drasche; while the remaining five—*Pharyngodictyon*, *Tylobranchion*, *Atopogaster*, *Morchellioides*, and *Psammaplidium*—are new groups founded for the reception of Challenger species.

Pharyngodictyon is more clearly distinguished than any of the others, and is certainly worthy of distinct generic rank. In fact, it differs so markedly from all the other Polyclinidæ in the structure of the branchial sac, that possibly it might be placed in a distinct family by itself. In regard to the others, it must be left an open question whether they are genera or subgenera. They are all tolerably closely allied, and some species present intermediate characters between two or more of them, thus rendering precise definition exceedingly difficult, if not impossible. On the other hand, it would be very inconvenient to regard the whole family, with the exception of *Pharyngodictyon*, as constituting a single enormous genus. I believe it will be found useful to retain the divisions as genera, at least until a much more complete knowledge of the species from all parts of the world of this variable and apparently very large family of the Compound Ascidians permits of a new and more natural classification.

Circinalium, Giard, *Fragarium*, Giard, *Parascidia*, Milne-Edwards, *Synoicum*, Phipps, *Sigillina*, Savigny, and *Polyclinoides*, von Drasche, do not occur in the Challenger collection, but the other eleven genera of the family are all represented.



Pharyngodictyon,[1] n. gen.

Colony club-shaped, or consisting of a "head" placed on a short peduncle.

Systems inconspicuous.

Ascidiozooids very long antero-posteriorly, and distinctly divided into regions.

Test of a firm gelatinous consistence.

[1] From φάρυγξ and δίκτυον.

Branchial Sac formed of a simple meshwork of longitudinal and transverse vessels. No true stigmata present.

Dorsal Lamina represented by a series of languets.

Reproductive Organs placed in a long post-abdomen extending behind the intestinal loop.

This genus is formed for an interesting species obtained in the abyssal zone (1600 fathoms). In general appearance, and in the structure of most of the systems of the body, this form agrees with many of the other Polyclinidæ, but in the condition of the branchial sac it differs from all known species of Compound Ascidians, and exactly resembles the genera *Culeolus*, *Fungulus*, and *Bathyoncus* amongst Simple Ascidians. At first I felt inclined, on account of this great peculiarity, to regard this form as the type of a new family, but finally I decided to leave it as a very well marked genus of the Polyclinidæ. Further details and remarks are given under the specific description.

Pharyngodictyon mirabile, n. sp. (Pl. XXI. figs. 1–18).

The Colony consists of a more or less discoid mass, the "head," borne on a short peduncle. The upper surface of the head is usually flat, and nearly horizontal, while the lower tapers somewhat towards the top of the peduncle. The colony is attached by the base of the peduncle, which is considerably enlarged. The colour is light grey, with a slight yellowish tinge about the head. The surface is uneven and not very smooth. No common cloacal apertures are visible.

The length (from top of peduncle to upper surface of head) is 6 mm., and the breadth (greatest diameter of head) is 14 mm. The length of the peduncle is about 15 mm., and its thickness in the middle is 5 mm.

The Ascidiozooids are exceedingly long, and are placed nearly at right angles to the upper surface of the colony. Exclusive of the post-abdomen, containing the reproductive organs, the largest measure 4 mm. or 5 mm. antero-posteriorly. Beyond this the post-abdomen extends for fully as far again, and reaches into the peduncle. The anterior end of the Ascidiozooid is not wide, but a considerable part of the body is visible on the surface of the colony, forming a mark about 2 mm. in diameter.

The Test is moderately hard and firm. It is fairly transparent, and is of a greyish colour throughout. In sections the test is seen to consist of a perfectly structureless matrix, in which many small cells are imbedded. The cells are in some places very closely crowded. Most of them are round, but fusiform, triangular, and stellate forms also occur. They all have large nuclei, which stain very readily. No bladder cells are present.

The Mantle is moderately strong, and is provided with transverse equidistant muscle

bands of considerable size. Weaker longitudinal muscles are also present. The branchial sphincter is strong.

The Branchial Sac is long and rather narrow. It is very simple in its structure, consisting merely of transverse and longitudinal vessels intersecting at right angles, so as to form a large-meshed network. The meshes are a little longer vertically than transversely. The transverse and the longitudinal vessels are of the same size. They contain a few rather large muscle fibres.

The Tentacles are large. There are at least twelve, and they are all of much the same size.

The Dorsal Lamina is formed of a series of closely placed, irregularly triangular languets.

The Alimentary Canal is large.

The Reproductive Organs are large. They extend behind the intestine in the form of a long post-abdomen. Both ova and spermatic vesicles are present.

Locality.—Station 147, December 30, 1873 ; lat. 46° 16′ S., long. 48° 27′ E.; depth, 1600 fathoms ; bottom, Diatom ooze ; bottom temperature, 34°·2 F.

This interesting form is one of the few deep-sea Compound Ascidians. It was trawled at Station 147, between the Cape of Good Hope and Kerguelen Island, from a depth of 1600 fathoms.

In its fungus-like form it resembles some of the species of *Colella*. The shape, however, varies considerably in the six specimens. One of the colonies was considerably damaged ; a second is very small (Pl. XXI. fig. 3). The remaining four are of about the same size. In these the head is decidedly discoid in one specimen only (Pl. XXI. fig. 2). In two others it is flattish above and conical below. In the other colony it is in an intermediate condition. The three figures (Pl. XXI. figs. 1, 2, 3) show the amount of difference in the specimens. The upper surface of the head is irregular, being raised into slight elevations formed by the anterior ends of the Ascidiozooids. In some places the free edge of the disk is bent downwards so as to form a prominent ridge around the lower surface. The peduncle is thickest at the base of attachment, where it spreads out considerably. In one case this expanded base is over 13 mm. in diameter. Shells of Foraminifera and fragments of manganese are attached to and imbedded in the lower part of the peduncle. From the base the peduncle tapers upwards to its narrowest point just below the head, and then expands rapidly to pass into the under surface (see Pl. XXI. fig. 1).

The Ascidiozooids are very large ; including the reproductive organs they measure in some cases as much as 13 mm. in antero-posterior extent (see Pl. XXI. figs. 4, 5). They are, however, rather narrow ; the widest point is in the abdomen where the stomach is placed. The Ascidiozooids are not arranged with any regularity. They seem, however,

to be more numerous around the edges of the head, and the centre of the upper surface is more or less free from them. In one specimen there is an opening in the test at this point which is probably a common cloacal aperture. In two of the other colonies there is a distinct depression in the same region, and the surface of the test has a contracted appearance, so it is very probable that the centre of the upper surface is occupied by the common cloacal aperture, and that the Ascidiozooids are arranged more or less irregularly around this spot. The thorax of the Ascidiozooid is longer than the abdomen, but not so wide (see Pl. XXI. fig. 5), while the post-abdomen is longer than the thorax and the abdomen together.

The Ascidiozooids are of a pale opaque yellow colour, the test being grey and transparent. The test is very firm. Its surface glistens in parts but is not very smooth. Here and there a few grains of sand are found adhering. The test cells are very numerous in some places (Pl. XXI. fig. 6, *t.c.*). The matrix, although apparently structureless, seems to be denser in some places than in others, and in these regions stains more deeply with aniline blue and picrocarmine (Pl. XXI. fig. 7).

The musculature of the mantle is strong. The transverse bands are especially large (Pl. XXI. fig. 8), while the weaker longitudinal bundles are not confined to the branchial region but are continued down to the post-abdomen. The branchial siphon is of considerable size, and is cylindrical in shape (Pl. XXI. fig. 5). The sphincter occupies a large area. The mantle as a whole is very opaque, except over the reproductive organs in the post-abdomen. The muscle fibres are fusiform and not long (Pl. XXI. figs. 10, 11); they have large central nuclei surrounded by granular protoplasm (Pl. XXI. figs. 9, 10, 11). These simple muscle fibres are grouped in bundles in such a way that their large nuclei come more or less in line, and form conspicuous bands crossing the muscles transversely (Pl. XXI. figs. 8, 9).

The branchial sac is the most remarkable organ in this species. It is exceedingly simple (Pl. XXI. fig. 12), and has exactly the structure which is found in some of the deep-sea Simple Ascidians (*e.g.*, the genera *Culeolus* and *Fungulus* in the Bolteninæ and *Bathyoncus* in the Styelinæ[1]).

The sac consists merely of transverse and longitudinal vessels of much the same calibre (see Pl. XXI. fig. 12, *tr.*, and *i.l.*). The spaces between them cannot be called stigmata on account of their large size and their nearly square shape. Also, as in the corresponding forms of branchial sac in Simple Ascidians, no cilia are present, this being another reason why the spaces should not be considered as stigmata. And yet if they are not stigmata the longitudinal vessels cannot correspond to the fine interstigmatic vessels of other forms, and must be regarded as internal longitudinal bars, which the similar vessels in *Culeolus* probably are. I prefer this alternative, although it necessitates the separation of this form from the other Polyclinidæ, none of which have

[1] See Part I. of this Report (in vol. vi., 1882, pp. 90, 122, 127, and 165).

internal longitudinal bars in the branchial sac. No calcareous spicules like those of *Culcolus* are present in the vessels of *Pharyngodictyon*, but a few rather large muscle fibres are found traversing them. The walls of the vessels are covered with squamous epithelium except on the internal edges of the longitudinal bars, where the cells become columnar and have tapering pointed free ends (Pl. XXI. fig. 13).

The endostyle is large and conspicuous. In side view (Pl. XXI. fig. 5) its course is nearly straight, but when seen in front view (Pl. XXI. fig. 16) the edges are found to be very much undulated. The very considerable breadth of the organ is also seen in this view.

The tentacles are large and fairly numerous. They are wide at their bases and recall by their appearance (Pl. XXI. fig. 14) the tentacles of some species of *Styela* amongst the Simple Ascidians. The upper surface of the tentacle is covered by a broad band of cubical epithelium (Pl. XXI. figs. 14, 15), while the sides and lower surface are formed of squamous cells. The usual septum of connective tissue is present in the interior (Pl. XXI. fig. 15).

The alimentary canal forms a large mass (Pl. XXI. fig. 5), including the widest portion of the body; it is very opaque. The stomach is a large ovate, thick-walled organ on the dorsal edge. It has ridges projecting into the interior. The intestine extends posteriorly for a short distance and then turns sharply to the ventral side and anteriorly. It is a large tube irregularly swollen with fæces at intervals. It forms the ventral edge of the visceral mass, and then crosses the œsophagus to reach the dorsal side of the branchial sac (Pl. XXI. fig. 5). In sections the stomach and intestine are found to contain great masses of a soft greyish colour composed mainly of Diatoms.[1]

The mature Ascidiozooids are hermaphrodite. The large genital organs lie completely posterior to the alimentary canal in a long diverticulum of the mantle, which is the post-abdomen. The anterior portion of the post-abdomen (Pl. XXI. fig. 5) is narrow and contains the genital ducts. Further back it swells into a fusiform body, in which the ova and the spermatic vesicles lie, and behind this it is continued into a long narrow tail which usually terminates in a slightly swollen extremity (Pl. XXI. fig. 5). One or two large yellow ova usually occupy the centre of the fusiform genital mass, while in front and behind are placed the small ovate or globular spermatic vesicles. The latter are usually about twelve or fifteen in number, and they stain a very deep red with picrocarmine. Each has a fine duct which runs upwards to join the vas deferens (Pl. XXI. fig. 17). This tube is large and conspicuous. It is formed at the upper end of the genital mass by the junction of the ducts from the spermatic vesicles (Pl. XXI. fig. 5), and runs forwards over the alimentary viscera to reach the rectum, up which it courses to its termination in the dorsal part of the peribranchial cavity. The upper part of the vas deferens is usually a little wider than the rest. The ova are of very

[1] The deposit on the bottom at Station 147, where this species was obtained, is Diatom ooze.

large size (Pl. XXI. fig. 5) and are usually rather opaque. In some sections of the genital mass their germinal vesicles and germinal spots are remarkably well seen, and a distinct dot inside the germinal spot is visible. Transverse sections through the post-abdomen behind the genital mass show that it is traversed by the usual double-walled thin septum, which is curved so that its lumen is sigmoid (Pl. XXI. fig. 18). The remainder of the post-abdomen is almost entirely formed of opaque mesoderm cells. Figure 18 represents an oblique section, and the three cavities at its upper end are spaces which were occupied by the spermatic vesicles forming the lower part of the genital mass.

Tylobranchion,[1] n. gen.

Colony large and massive.
Systems inconspicuous.
Ascidiozooids large, elongated antero-posteriorly, and distinctly divided into regions.
Test gelatinous.
Branchial Sac large and well developed. Transverse vessels provided with numerous large papillæ.
Dorsal Lamina represented by a series of languets.
Alimentary Canal large. Stomach-wall folded longitudinally.
Reproductive Organs forming a long post-abdomen.

This genus is distinguished from the other Polyclinidæ by the structure of the branchial sac. This organ is large and well developed, and it possesses numerous stigmata which vary considerably in size, but the most important point is that the transverse vessels, which are numerous and of large size, bear on their inner edges well-marked papillæ projecting into the cavity of the sac. These papillæ probably represent the connecting fibers of the Simple Ascidians, and if we regard the longitudinal vessels in the branchial sac of *Pharyngodictyon mirabile* as being internal longitudinal bars, then the present genus will occupy an intermediate position between that form and the other Polyclinidæ as regards the development of this part of the branchial sac. Further remarks will be found under the description of the single species.

Tylobranchion speciosum, n. sp. (Pl. XXII. figs. 1–17).

The Colony is irregularly wedge-shaped, with the larger end uppermost. The base of attachment at the posterior end is comparatively small, and from this point the colony

[1] From τύλος and βράγχια.

increases in size towards the top, which is large and irregularly convex. The posterior half or two-thirds forms a short stout peduncle. The colour varies from dark grey near the point of attachment to light yellowish-grey at the upper end. The surface is very uneven, but is smooth and glistening.

The length is about 8 cm., the greatest breadth is 5·5 cm., and the greatest thickness is 2·5 cm.

The Ascidiozooids are very large (up to 2 cm. in antero-posterior extent, and about 2·5 mm. at the widest point). The body is divided into three distinct regions; the thorax is about 4 mm. in length, the abdomen 3 mm., and the post-abdomen from 2 mm. to 14 mm. in length. The branchial and the atrial apertures are both six-lobed. The Ascidiozooids are placed vertically in the colony, with their anterior ends on the convex upper surface; there is no arrangement in systems, and no common cloacal apertures are present.

The Test is firm and cartilaginous in the lower part of the colony, but soft and gelatinous in the upper part. It is semi-transparent and of a grey colour throughout, varying from a dark bluish-grey at the posterior end to a light yellowish-grey on the upper surface. The matrix of the test is crowded with minute cells of various shapes; no bladder cells or pigment cells are present. There are very few vessels in the test.

The Mantle is strong, and has a well-developed musculature. The muscle bands on the branchial region are very thick, and they branch to form an irregular network. Over the long genital region of the body the mantle contains a number of closely placed longitudinally running bundles of muscle fibres. These are narrow, and do not branch. In the intestinal region the mantle is thin, with little or no musculature.

The Branchial Sac is large, and contains a great number of stigmata, which vary in size from small round openings to very long narrow slits. The transverse vessels differ greatly in their breadth. Where they lie between rows of small stigmata they are very broad, but where the stigmata in the adjacent rows are long, the transverse vessels are considerably reduced in size. There are no horizontal membranes, but the transverse vessels bear rows of irregularly shaped papillæ projecting into the interior of the sac, and usually having their free ends more or less lobed. As a rule, these papillæ are largest where the neighbouring stigmata are small.

The Endostyle is large and conspicuous. It has a very undulating course.

The Dorsal Lamina is formed of a large number of closely placed languets.

The Tentacles are numerous and of different lengths, but are not arranged with any regularity.

The Dorsal Tubercle is in the form of an ovate slit of considerable size, surrounded by broad raised margins.

The Alimentary Canal is large, and is of an opaque greyish-yellow colour. The stomach is large, and its wall is longitudinally folded. The rectum is very wide.

The Reproductive Organs are placed behind the intestinal loop, and may extend posteriorly for a great distance. They are usually over 1 cm. in length.

Locality.—(*a*) Kerguelen Island, 10 to 60 fathoms ; one large and one small colony. (*b*) Kerguelen Island, 10 to 100 fathoms ; one small colony.

Three specimens of this remarkable species were obtained at Kerguelen Island, at depths between 10 and 100 fathoms. One of them is a large colony (Pl. XXII. fig. 1), from which the description and measurements given above are taken, the other two are very much smaller.

The large colony has been evidently flattened somewhat during preservation; the natural thickness was therefore probably greater than what is stated above. The upper part is formed of two masses, each with a separate short peduncle, which join about one-third of the way down. One of the "heads" is considerably larger than the other, but in all other particulars they agree closely. The posterior part of the colony forming the common peduncle is about 3 cm. in its greatest thickness. It is formed of dark grey test, with a slight slate-blue tinge. This region expands rapidly above to form the convex upper part of the colony in which the Ascidiozooids are imbedded (Pl. XXII. fig. 1). Here the colour is lighter and has a yellowish tint, and the test is much softer and more yielding than lower down. The outer layer of test over the whole colony is very smooth and glistening, but it does not form a firmer or harder layer which may be stripped off as in the case of some other Compound Ascidians. The bodies of the Ascidiozooids show through the test of the upper part of the colony as long, opaque, yellow bands, becoming indistinct at their lower ends, where they are not so opaque, and the surrounding test is less transparent (Pl. XXII. fig. 1).

The Ascidiozooids are not arranged with any regularity, but occur at fairly equal distances all through the test in the upper part of the colony. Their anterior ends in many cases form small papillæ, while in other cases the Ascidiozooids have contracted away from the superficial layer of test, and occupy depressions.

The two smaller colonies are nearly of the same size, the one being 2·5 cm. long and 1 cm. broad at the top, and the other 3·5 cm. long and about 1·5 cm. broad. The general shape of body is much the same as in the large colony. The specimen from "Kerguelen, 10 to 100 fathoms"—the smallest colony—is less wedge-shaped than the others, and would be more properly described as irregularly club-shaped. The peduncle is narrow, and the upper part occupied by the Ascidiozooids is rounded, there being no lateral compression.

The Ascidiozooids in all three colonies are very large. They vary from 1 cm. to 2 cm. in antero-posterior length (Pl. XXII. figs. 2, 3), and are generally about 2 mm. across at the widest part, which is near the anterior end. The three regions of which the body is formed correspond to Milne-Edwards' "thorax," "abdomen," and "post-

abdomen," and the great difference in length between different Ascidiozooids is mainly due to variations in the size of the post-abdomen or genital region. In some it is very small, being merely a short conical projection extending scarcely 2 mm. behind the intestinal loop (Pl. XXII. fig. 2), while in others (most of the Ascidiozooids) it forms a very long appendage, which may be twice as long as the rest of the body, though not so wide (Pl. XXII. fig. 3).

The test is exceedingly full of small test cells, exhibiting the usual variety in shape. Most of them are round, or nearly so, elongated and branched forms being less common (Pl. XXII. fig. 5). There are apparently no bladder cells even in the outer layer of the upper part of the colony, a region where they are generally seen. Delicate vascular appendages extend from the posterior extremities of the Ascidiozooids (Pl. XXII. fig. 4) downwards through the lower part of the colony. Some of them are just visible to the eye as fine lines in the dark grey test forming the peduncle.

In all the colonies there is a distinct line in the test marking the point where the upper soft convex mass, containing the branchial and intestinal parts of the Ascidiozooids (Pl. XXII. fig. 1), joins the peduncle, in which the genital regions and the vascular appendages are placed. Above this line the test is distinctly more of a yellowish tint than below it.

The ectoderm is very distinct, and can be separated as a coherent membrane from the test and the mantle. The mantle is very muscular, especially over the branchial region of the body, where the musculature is more like that of an *Ascidia* or a *Corella* than of a Compound Ascidian (see Pl. XXII. fig. 4).

Over the intestinal part of the body the muscles are not entirely absent, but they are much more feebly developed, and consist of fine bands running mainly in a longitudinal direction and occasionally branching and interlacing (Pl. XXII. fig. 4). On the post-abdomen or genital region the musculature is rather stronger, and is composed of a large number of longitudinal bands running nearly parallel to one another and forming a well-marked muscular investment to the reproductive organs. The branchial and atrial apertures are each provided with six well-marked lobes (Pl. XXII. fig. 4), and the sphincters are well developed.

The branchial sac is the most characteristic and remarkable organ of this species. It is very large, and has an enormous number of stigmata for a Compound Ascidian. These stigmata vary greatly in size, some rows being exceedingly small circular openings (Pl. XXII. fig. 8, *sg.*), while others are long narrow slits like the stigmata of a Simple Ascidian (Pl. XXII. fig. 9, *sg.*). In the small stigmata the ciliated stigmatic cells are small and rounded (Pl. XXII. fig. 10, *sg.*), while in the long narrow stigmata the cells are well defined with triangular projecting free ends (Pl. XXII. fig. 11). There are connectives running between the transverse vessels and the sinuses in the mantle outside.

The transverse vessels, which vary greatly in size, being in some places several times

as wide as the length of the adjacent stigmata, are produced inwards to form series of hollow papillæ of various sizes and shapes. These papillæ are arranged with a certain amount of regularity. They form a single row only on each transverse vessel, and they are placed at equidistant points, but they are much more developed in some parts of the sac than in others, while in some regions they are altogether absent (Pl. XXII. fig. 8). Where they are large their free ends show a tendency to split into two or three branches (Pl. XXII. figs. 7, 10, *p.*), and this as well as their equidistant arrangement gives them very much the appearance of the connecting ducts and rudimentary internal longitudinal bars often seen on the transverse vessels of some Simple Ascidians (*e.g.*, *Corella parallelogramma*, *Corella japonica*, and *Ascidia triangularis*[1]). In some parts of the sac where the papillæ are rather wide, flattened, and triangular in shape, with the ends unbranched, they resemble the large triangular connecting ducts of some Clavelinidæ (*Ecteinascidia crassa* and *Ecteinascidia fusca*),[2] and I think there can be no doubt that they really are connecting ducts in a rudimentary condition. The only question is whether this species should be regarded as a form in which internal longitudinal bars are beginning to develop, or one in which, as the result of degeneration, these structures have been lost, with the exception of the papillæ representing the rudimentary connecting ducts. The answer to this question involves a discussion of the probable phylogeny of the Compound Ascidians, and may therefore be deferred to the general summary at the conclusion of this Report.

The languets representing the dorsal lamina are long and narrow, and are not flattened antero-posteriorly. They have much more of the shape of a tentacle than is usual, and closely resemble the languets of *Ecteinascidia turbinata*[3] amongst Simple Ascidians. They obviously correspond to the papillæ on the transverse vessels with which they are in series (Pl. XXII. fig. 12, *l.*), and from which they only differ in size. This adds to the arguments which I have already brought forward[4] in favour of the languets being homologous with the connecting ducts, and not with the papillæ which project from the internal longitudinal bars in many Simple Ascidians.

The tentacles are numerous and closely placed (Pl. XXII. fig. 13, *tr.*). Most of them are long. Some are shorter, but they do not occur in any definite order. The endostyle undulates considerably from side to side (Pl. XXII. fig. 6).

The peripharyngeal band is well marked (Pl. XXII. fig. 13, *p.p.*). It curves posteriorly in the dorsal region to form a moderately deep peritubercular area in which the large but simple dorsal tubercle lies. The opening of this organ is a narrow ovate slit, with the wider end posterior (Pl. XXII. fig. 13, *d.t.*). The margin is broad and conspicuous. The tubercle touches the peripharyngeal band with its posterior

[1] See Herdman, part i. of this Report (vol. vi. 1882), p. 192, pl. xxvi. fig. 8; and Notes on British Tunicata, *Journ. Linn. Soc. Zool.*, vol. xv. p. 283, 1880.

[2] Part i. of this Report (vol. vi. 1882), pp. 240, 242, pl. xxxvi. figs. 8, 13, 14.

[3] *Loc. cit.*, p. 243, pl. xxxvi. fig. 6.

[4] *Loc. cit.*, p. 284.

edge, leaving a wide prebranchial zone between its anterior end and the bases of the tentacles.

The œsophagus commences at the posterior end of the dorsal edge of the branchial sac and runs directly backwards (Pl. XXII. fig. 4). It is a long and narrow tube with moderately thick walls slightly corrugated in parts. The stomach is a large ovate organ with its long axis placed antero-posteriorly, and with the narrower end forwards. The walls, which are only moderately thick, are folded longitudinally (Pl. XXII. fig. 4). The intestine, after leaving the posterior end of the stomach, from which it is separated by a marked constriction, runs for a short distance backwards, and then turns round dorsally and anteriorly to continue its course forwards, as the rectum, lying at first alongside the stomach and œsophagus, and then running up the dorsal edge of the branchial sac to the anus, which is placed far forwards in the peribranchial chamber close to the atrial aperture. The intestine where it leaves the stomach is rather thick-walled and narrow, not much wider than the œsophagus, but while curving round at the posterior end it becomes rapidly wider and its wall is greatly reduced in thickness. The rectum is nearly as wide as the stomach (Pl. XXII. fig. 4), and its wall is so thin as to be almost transparent. The fæces are of a brownish colour, and are composed mainly of Diatoms.

The reproductive organs forming the post-abdomen vary greatly in size, but in nearly all the Ascidiozooids examined they consist merely of spermatic vesicles and their ducts. Large ova, of an opaque orange colour, and embryos in various stages of development are common, however, in the peribranchial cavity, which is in some cases greatly distended with them. Possibly the ova are only produced at a certain season of the year, but I think it much more probable that they are formed at a certain period in the life of the Ascidiozooid. Ova in various stages were found in one or two of the younger and smaller Ascidiozooids, but certainly all the large specimens which I examined were male. Probably the ova are formed first, and pass up into the peribranchial cavity when the testes begin to develop.

Figure 14 in Plate XXII. represents a diagrammatic transverse section through the post-abdomen of a young Ascidiozooid. It is formed of an outer coating of ectoderm (*ec.*), inside which is a layer of connective tissue with muscle bands (*m.b.*). This is the mantle, and it encloses a mass of mesoderm tissue traversed by branching tubes (*g.t.*) containing germinal cells. Around these reproductive tubes are blood-sinuses (*b.s*) containing blood-corpuscles. Figures 15 and 16 show a small part of a section of a young post-abdomen where the germinal cells are seen in various stages of development into ova. Figure 17 gives a similar view of part of the post-abdomen of a larger and older Ascidiozooid, where the reproductive tubes have their branches much dilated at the ends to form spherical or ovate bulbs more or less filled with developing spermatozoa. The mantle and the blood-sinuses remain unchanged. Evidently the young

Ascidiozooid is female and the older one male, and the ova and spermatozoa develop from mesodermal cells in the same reproductive tubules, which, however, become more numerous and change their shape somewhat when being converted into spermatic vesicles. The vas deferens is very long and convoluted, and is conspicuous from near the top of the post-abdomen onwards. It adheres to the rectum along its entire length, and terminates a short distance in front of the anus.

This species is particularly interesting on account of the resemblances it shows to some of the Ascidiæ Simplices. From its general anatomy, and especially from the relations of the intestine to the branchial sac and the reproductive organs, it is clearly a member of the family Polyclinidæ, but the musculature of the mantle is quite unlike that of most Compound Ascidians. The muscle bands in the thoracic region, while branching and anastomosing irregularly, have their main lines more or less antero-posterior (Pl. XXII. fig. 4), while the general rule amongst Compound Ascidians is that the chief muscle bands should run transversely. Then the branchial sac shows resemblances to the Clavelinidæ in the large number of stigmata, in the presence of the rudimentary connecting ducts on the transverse vessels, and in the long, narrow languets. Lastly, the tentacles are numerous and closely placed at their bases (Pl. XXII. fig. 13), just as in many Ascidiæ Simplices, while in Compound Ascidians, as a rule, the tentacles are few in number (usually eight or sixteen), and are arranged regularly at equal distances apart.

Atopogaster,[1] n. gen.

Colony massive, and usually of large size.
Systems simple or inconspicuous.
Ascidiozooids large or small, always much elongated antero-posteriorly. Branchial aperture six-lobed.
Test thick, and usually cartilaginous and tough; not incrusted with sand.
Branchial Sac usually well developed.
Alimentary Canal large. Stomach-wall folded transversely.
Post-Abdomen long.

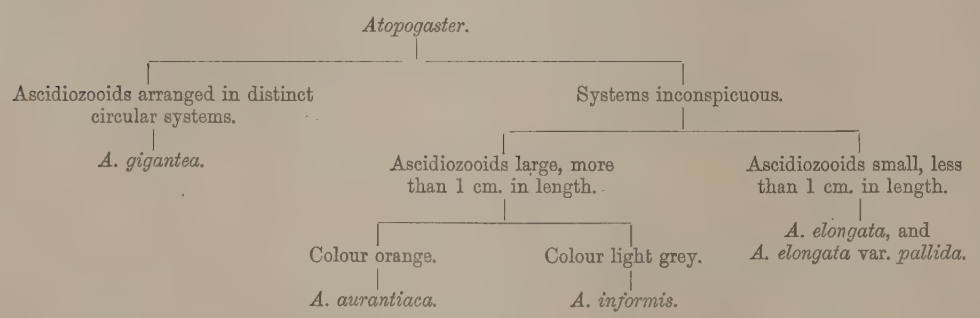
I have separated this little group of species from the other Polyclinidæ on account of their possessing a large stomach, the wall of which is thrown into transverse folds. It is very convenient to make use of the characters of the stomach-wall in dividing up this family into sections, a course pursued first by Giard; but I am doubtful whether the groups so produced are in all cases natural. In the present genus the mere presence of folds distinguishes from *Synoicum*, *Morchellium*, *Morchellioides*, and *Sidnyum*, while

[1] From ἄτοπος and γαστήρ.

their transverse direction separates the group from *Polyclinoides*, *Amaroucium*, and *Sigillina* (see Table, p. 152); but in general appearance, and especially in size of Ascidiozooid, *Atopogaster aurantiaca* and *Atopogaster elongata* differ so remarkably that I am inclined to think that they ought to belong to distinct sections of the family. Then in some respects *Atopogaster aurantiaca* appears to be allied to *Tylobranchion speciosum*, from which, however, it differs totally in the condition of the branchial sac. *Atopogaster gigantea*, again, differs from the other members of the genus in the simple and conspicuous systems formed by the Ascidiozooids (see Pl. XXIII. fig. 2), and in this respect approaches some species of *Polyclinum* (see *Polyclinum pyriformis*). The relationships of the different Polyclinidæ are very complicated. They seem to form an irregular network, and it is very difficult to determine which characters indicate most clearly the genetic affinity.

In all the species of this genus, however, the colony is massive, the amount of test present is large, and it is tough and cartilaginous in its nature; the Ascidiozooids are greatly elongated antero-posteriorly, and the post-abdomen is large; and lastly, in all, the stomach is more or less distinctly folded in a transverse direction.

The species may be distinguished by means of the following table :—



This arrangement divides the genus into three sections which seem to be natural :— (1) With distinct systems, *Atopogaster gigantea*; (2) with very large Ascidiozooids, *Atopogaster aurantiaca* and *Atopogaster informis*; and (3) with small Ascidiozooids, *Atopogaster elongata*, and *Atopogaster elongata* var. *pallida*.

Atopogaster gigantea, n. sp. (Pl. XXIII. figs. 1–6).

The Colony is a very large mass of elongated form attached by the posterior end, and extending upwards with a slight curve to a considerable height. It narrows gradually above the middle, and the upper end is obtusely pointed. The colony is slightly compressed laterally. The colour is an opaque whitish-grey with a slight hyaline tinge in places. The surface is somewhat uneven, and is slightly rough all over.

The length of the colony is 26 cm., the greatest breadth is 7·5 cm., and the average thickness is 4 cm.

The Ascidiozooids are very long and narrow, and are placed more or less vertically in the test. They are arranged in circular systems, consisting each of from six to twelve Ascidiozooids arranged around a centrally placed common cloaca. The body is usually over 1 cm. in length, and consists of three well-defined regions. The thorax is about 2 mm. in antero-posterior length, and rather more than 1 mm. in breadth (dorso-ventrally). The abdomen is narrower, and is usually 3 or 4 mm. in length, while the post-abdomen may be short—a few millimetres—but more usually extends as a narrow undulating thread for a considerable distance downwards into the colony.

The Test is firm and cartilaginous but not hard. It is of a light grey colour, and is semi-transparent. The matrix is clear and homogeneous, and the small test cells are numerous. There are no bladder cells.

The Mantle is not strong. The muscle bands run mainly in a longitudinal direction. They are narrow and not very numerous.

The Branchial Sac is fairly large. The transverse vessels are wide, and are supplied with muscle fibres. The stigmata are wider than the fine longitudinal vessels, and are arranged with regularity.

The Dorsal Lamina is represented by a series of pointed languets.

The Tentacles are rather small, and they are not numerous.

The Dorsal Tubercle has a small round aperture.

Locality.—Station 313, January 20, 1876; lat. 52° 20′ S., long 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8 F.

This is the largest Compound Ascidian in the Challenger collection, and, like so many other large Tunicata (*e.g.*, *Molgula gigantea* and *Goodsiria coccinea*), was obtained in the Strait of Magellan. The colony is an elongated mass (Pl. XXIII. fig. 1[1]), and was evidently attached by one end, upon which it stood upright in the water. The lower end has small stones, sand-grains, &c., imbedded in it for a distance of from 1 cm. to 3 cm., and some colonies of Hydroid Zoophytes are attached to this region. The widest point is about half way up, and from this region it tapers slightly both upwards and downwards equally till it reaches about 3 cm. from the top or the base. At these points the width is about 5 cm. The upper end has a rounded point. The colour is fairly uniform all over. The few places where a slight hyaline tint is seen are regions where there are no Ascidiozooids, and where therefore test alone is seen. The general roughness of the surface is caused in great part by the anterior ends of the Ascidiozooids usually projecting slightly beyond the level of the test, but besides this there are slight grooves and ridges, due possibly to the contraction of the test on being placed in alcohol.

[1] This figure represents the colony reduced to one half of the natural size.

The Ascidiozooids, of which there are probably ten or twelve thousand, are arranged in systems which are clearly visible on the outside of the colony, on account of the test being decidedly more transparent than the whitish-grey bodies of the Ascidiozooids. The systems are mostly circular in outline (Pl. XXIII. fig. 2), like those of the genus *Botryllus*, but in some cases they are elliptical, ovate, crescentic, or more irregular; they never form branched lines as in *Botrylloides*. Each system has a centrally placed common cloaca, usually of large size and distinctly visible. Many of these cavities are occupied by Copepoda, and the legs of the Crustaceans may usually be seen projecting from the openings. The systems are closely placed, and are nearly equally numerous over all parts of the colony. An average sized system has nine or ten Ascidiozooids, and is about 5 mm. in diameter.

The Ascidiozooids, although small relatively to the size of the colony, are of considerable length. The anterior end, which is visible on the outside, is only about 0·5 mm. in diameter. The middle of the thorax is the widest region, while the abdomen and post-abdomen are both narrow, especially the latter (Pl. XXIII. fig. 3). The widest part of the abdomen is about its middle, as it is connected with the thorax by a narrower region anteriorly, and tapers posteriorly to join the genital region. The post-abdomen is usually very long and narrow, and the test in all parts of the colony is found to be penetrated by the delicate thread-like posterior ends of the bodies of the Ascidiozooids. Even the very centre of the colony at the widest part, where it is at least 2 or 3 cm. from the surface, is traversed in all directions by these threads. They are, like the rest of the body, of an opaque pale yellowish-white colour, and have an irregularly undulating course. The anterior part of the Ascidiozooid is placed approximately at right angles to the outer surface, but the posterior part becomes bent so as to run downwards towards the base of the colony.

The test is a solid firm mass but it is not hard, and is transparent in small pieces. The small test cells are very numerous and are of all shapes; some very beautifully branched forms occur. The test is slightly softer and less dense, and contains more cells, in a layer immediately surrounding the bodies of the Ascidiozooids. This is seen very clearly in sections stained with aniline blue, where this layer takes on the stain a little differently from the remainder of the test, and is thus rendered conspicuous. Many of the cells are very granular, but there are no opaque pigment-corpuscles present. The cells are particularly granular near the edges of the colony, where the test is growing most rapidly, and they are arranged more or less regularly in rows running parallel with the outer surface.

The mantle varies considerably in the different regions of the body. Over the branchial sac the muscle bands are rather distant. Some transverse muscles are present, but the longitudinal bands are the most important. Over the abdominal viscera there are no transverse muscles, and the longitudinal ones are few and slight, but on the post-

abdomen the longitudinal bands become more numerous and form a strong muscular investment to the reproductive organs. The branchial siphon is rather long (Pl. XXIII. figs. 3, 5), and its anterior end is distinctly six-lobed. In some cases the lobes are large and widely separated (Pl. XXIII. fig. 5). The sphincter is well developed.

The branchial sac is rather long and narrow, and contains many rows of stigmata. The most noteworthy feature in regard to it is the comparatively great width of the transverse vessels, which are all of the same size, and have bands of muscle fibres running along their length (Pl. XXIII. fig. 4, *m.f.*). In some specimens neither the transverse vessels nor the stigmata are quite so wide as the figure shows. The ciliated cells placed along the sides of the stigmata are large and distinct, and have their free ends pointed.

The endostyle is narrow and inconspicuous, its course is undulating. The languets are not numerous, but they are rather large; they are tentacular in form and are pointed. The tentacles are rather inconspicuous, and the aperture of the dorsal tubercle is very small. The nerve-ganglion is large and globular.

The alimentary canal forms a long narrow loop (Pl. XXIII. fig. 3). The œsophagus commences at the posterior end of the dorsal edge of the branchial sac, and runs directly backwards. It is funnel-shaped at its upper end (Pl. XXIII. fig. 3, *œ.*), and then rapidly narrows to form a slender tube which opens into the anterior extremity of the somewhat ovate stomach. The long axis of the stomach is directed antero-posteriorly, and the anterior end is the wider and more rounded of the two. The wall of the stomach is usually somewhat folded transversely. The intestine emerges from the narrow posterior end of the stomach, and runs backwards as a tube of variable calibre and irregular course (Pl. XXIII. fig. 3, *i.*). It then turns round ventrally and anteriorly, and becoming suddenly wider runs forwards as the rectum parallel to the intestine, stomach, and œsophagus to reach the posterior end of the branchial sac, where it crosses over to the dorsal side, and finally opens into the peribranchial cavity.

The reproductive organs lie completely behind the intestinal loop. Both ova and spermatic vesicles may be found in the same Ascidiozooid. The vas deferens is a long tube, but it is not so conspicuous as is usual in the Compound Ascidians. Tailed larvæ were found in some Ascidiozooids lying in considerable numbers in the peribranchial cavities. They have long narrow bodies (Pl. XXIII. fig. 6) provided anteriorly with three slender adhering papillæ, and the pigmented sense-organs (of which two are present) are placed close together near the posterior end of the body.

In several of the Ascidiozooids ova of smaller size than those in the post-abdomen and small embryos in various stages of development were found in the dorsal part of the peribranchial cavity. A careful examination showed that these were Crustacean embryos, and a few completely developed Nauplii were found amongst them. They evidently belong to the Copepoda living in the common cloacal cavities of the colony, and as the

peribranchial cavity communicates directly with the common cloacal cavity through the atrial aperture, it is easy to understand how the Copepod might pass its ova into the peribranchial cavities of adjoining Ascidiozooids and use them as incubatory pouches. In one or two cases the larval Ascidians and the larval Crustaceans were found developing side by side in the same peribranchial cavity.

Atopogaster aurantiaca, n. sp. (Pl. XXIII. figs. 7–13).

The Colony is irregularly wedge-shaped, with the larger end uppermost. The point of attachment, which is placed at the posterior end, is comparatively small, and the colony increases rapidly in size towards the top, which is very large and irregularly convex. The posterior two-thirds of the colony forms a short and very stout peduncle. The colour is orange, having in some places a greyish tint and in other places becoming reddish-brown. The surface is uneven but smooth.

The length is about 7 cm., the greatest breadth is 6·5 cm., and the greatest thickness 4·5 cm.

The Ascidiozooids are very long (up to about 3 cm. in antero-posterior extent, and about 2·5 mm. at the widest point). The body is divided into three regions, of which the abdomen or intestinal part is very much the largest, being more than twice as long as the other two regions together. The Ascidiozooids are placed more or less vertically in the colony, with their anterior ends on the large upper surface; there is no arrangement in systems, and no common cloacal apertures are present.

The Test is firm and cartilaginous all over, but is particularly hard in the lower part of the colony. It is semi-transparent and is of a yellowish or orange-grey colour throughout. It is darker towards the posterior end and lighter on the upper surface. The matrix of the test contains many small cells of various shapes, in some places closely crowded together. There are very few vessels and bladder cells in the test.

The Mantle is moderately thick, and is nearly equally muscular all over the anterior half of the body. The muscle bands are fine but very numerous, and they nearly all run longitudinally. The sphincters are well developed, and both apertures are deeply six-lobed.

The Branchial Sac is of moderate size and has many stigmata placed in about twenty regular rows. The transverse vessels are all of the same size, and bear short horizontal membranes which project inwards. The stigmata are all of much the same size, and are arranged with regularity. They are of moderate length, and the ciliated cells are large and pointed at their free ends.

The Endostyle is large and conspicuous, its course is very undulating.

The Dorsal Lamina is formed of a large number of long narrow pointed languets.

The Tentacles are large and fairly numerous; they are not all of one length.

The Dorsal Tubercle is placed far forward near to the base of the tentacles. It is inconspicuous and has a simple opening.

The Alimentary Canal is remarkable on account of its very great length. The stomach is elongated and is folded transversely, and the intestine is exceedingly long.

The Reproductive Organs are placed at the posterior end of the body and extend for a variable distance beyond the intestinal loop. They are hermaphrodite.

Locality.—Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; depth, 38 fathoms; bottom, sand and shells.

This species is founded for a single large colony obtained in Bass' Strait, between Australia and Moncœur Island, from a depth of 38 to 40 fathoms. It seems to be allied in some respects to the previously described *Tylobranchion speciosum*, but differs from it in many points, both of external appearance and internal structure, which are discussed below.

The colony is short and broad, and is wedge-shaped as seen in lateral view (Pl. XXIII. fig. 7). The base of attachment is much smaller than in the last species, being only about 2 cm. in diameter. The upper surface seems to have been unnaturally flattened during preservation. Probably when living it was slightly convex all over. The peduncle is 5·5 cm. in thickness at its upper end, and there is a distinct line where it joins the upper softer region of the colony.

The general colour is orange. On the peduncle it is tinged with grey, while in some parts of the upper surface it becomes a reddish-brown or burnt sienna. The outer layer of test over the whole colony is very smooth. The surface is much more even on the peduncle than elsewhere.

The bodies of the Ascidiozooids show through very slightly as the test is not nearly so transparent as in the case of *Tylobranchion speciosum*. The Ascidiozooids are not arranged with any regularity; their anterior ends occupy depressions in the surface layer of the test. They are probably larger than the Ascidiozooids of any other known Compound Ascidian. In one measuring 2·5 cm. in antero-posterior extent, the thorax is 7 mm. in length, the abdomen 15 mm., and the genital part or post-abdomen 3 mm. In some Ascidiozooids the genital region is much larger.

The apertures are very closely placed at the anterior end of the body, and in the greater part of its length the Ascidiozooid is relatively very narrow. The widest region is towards the posterior end of the abdomen, the thorax being unusually narrow. A branchial region 7 mm. in length is only 1·5 mm. wide.

The test is very much harder than in the case of *Tylobranchion speciosum*, but, like it, is rather softer on the upper surface than elsewhere. The yellow or light colour of the test is much more marked in the outer part than in the deeper layers, where it is grey with a slight yellowish tinge. The test cells are numerous and of rather large

size (Pl. XXIII. fig. 9, *t.c.*). They exhibit the usual variety of shape and have a granular appearance. Pigmented cells are fairly numerous. In some places they are scattered singly and have a rounded form. In others they are aggregated to form small clumps in which the individual cells are more or less polygonal from mutual pressure (Pl. XXIII. fig. 9, *p.c.*). These pigmented cells are of a light yellow colour in thin unstained sections. They stain readily with picrocarmine, aniline blue, and other dyes. There are a few bladder cells in the outer layers of the test but none in the deeper parts. The vessels are narrow, not at all numerous, and end in elongated bulbs (Pl. XXIII. fig. 9, *t.k.*). The matrix as a rule is homogeneous in appearance, but in some places it is very slightly fibrillated. The ectoderm is very well marked, and can be separated from both test and mantle, between which it lies, as a distinct membrane.

The mantle is remarkable on account of the longitudinal arrangement of nearly all the muscle bands. They are very delicate but fairly numerous, and are arranged with great regularity. They form a moderately strong musculature on the branchial region of the body, which becomes much less powerful as it is traced posteriorly over the viscera. On the lower part of the abdomen and on the post-abdomen the muscle bands are few and very narrow. The sphincters around the apertures are fairly well developed. The mantle is deeply cleft, at both branchial and atrial apertures, into six regularly shaped and equal lobes (Pl. XXIII. fig. 8).

The transverse vessels of the branchial sac are wide and have well-marked horizontal membranes, but no papillæ or other projections are present. The stigmata are much more regularly placed than in *Tylobranchion speciosum*, and are of a fair size (Pl. XXIII. fig. 10, *sg.*). All the vessels of the sac are rather thick walled and opaque. The endostyle is like that of *Tylobranchion speciosum*.

There are about twenty languets. They are long and narrow, and are scarcely at all flattened (Pl. XXIII. fig. 12, *l.*). Each languet is continuous with one of the horizontal membranes (*h.m.*) of the branchial sac, and the series is connected by a slightly thickened ridge of epithelium (*ep.*), behind which are placed close together two parallel bands of muscle fibres (Pl. XXIII. figs. 11, 12, *m.f.*).

The tentacles are large and rather irregular in size and position. The dorsal tubercle is inconspicuous. It has a rounded opening placed near the base of the tentacles, and leading into a large infundibulum which may be traced into a narrow neural duct leading backwards behind the prebranchial zone. There is a well-marked peritubercular area formed by the bending posteriorly of the peripharyngeal bands, but the tubercle is placed far in front of it.

The œsophageal aperture is placed at the dorsal edge of the posterior end of the branchial sac, and leads at once into an elongated stomach which is directed posteriorly, and has its wall thrown into a series of strongly marked transverse folds. These are lined with columnar ciliated epithelium, and they form a conspicuous feature in the

otherwise simple alimentary canal. The intestine is thin walled and of great length. It stretches for a considerable distance beyond the stomach posteriorly, and then turns round to run forwards parallel to its first part and to the stomach. The intestinal loop is thus very long and narrow. The rectum does not extend very far forwards.

The post-abdomen contains both mature ova and spermatic vesicles, so that both reproductive elements seem to be formed in the Ascidiozooid at the same time in this species. The reproductive organs are not confined to the post-abdomen, but cover also a part of the long intestinal loop. The distance to which the post-abdomen may extend is very variable. The numerous spermatic vesicles are ovate or elliptical in form, and are united in groups by delicate ducts which join to form the vas deferens. This is a wide and rather conspicuous opaque tube which is coiled spirally and may be traced forwards alongside the intestine and rectum to the peribranchial cavity. In its entire extent its course is greatly convoluted. The mature ova are large and of an opaque yellow colour. Embryos and tailed larvæ are found in the peribranchial cavity, mainly on the dorsal edge, but there is no incubatory pouch. The tailed larvæ are large (Pl. XXIII. fig. 13), and have three very conspicuous adhering organs placed anteriorly. There is only one pigmented sense-organ, and it is placed near the posterior end of the body.

Atopogaster informis, n. sp. (Pl. XXIV. figs. 11–15).

The Colony must have been of large size, and probably was more or less rounded in form and not pedunculated. The colour is light grey, and the surface is rather uneven.

The Ascidiozooids are large, and have rather a long and narrow shape; they are about 1·2 cm. antero-posteriorly and 1 mm. in greatest breadth. The body is not distinctly divided into regions.

The Test is firm and cartilaginous. It is of a pale grey colour, and is fairly transparent. The homogeneous matrix is crowded with small rounded test cells, and no bladder cells are present.

The Mantle is moderately strong, and the musculature is well developed on the thoracic part of the body. The muscle bands are nearly all longitudinal, and they run with great regularity. There is little or no musculature on the abdomen and post-abdomen.

The Branchial Sac is fairly large, and the stigmata are numerous. The transverse vessels are wide and have no horizontal membranes. The stigmata are of moderate length and are regularly placed.

The Dorsal Lamina is represented by a series of short stout languets.

The Tentacles are large and numerous; they are all of much the same size.

Locality.—Unknown.

This species is based upon a fragment of a colony which was found in a bottle containing a number of pieces of Compound Ascidians preserved in absolute alcohol.

None of these have any localities attached to them, but most of them are merely pieces taken from colonies which occur in the collection, and therefore they can be readily referred to their proper species and localities. In the case of the present specimen, however, and one or two others, there is nothing else belonging to the same species in the collection, and therefore there is no clue to the locality from which it was obtained.

The specimen is a slice cut out of a large colony, and measures rather more than 9 cm. in length by about 4 cm. in greatest breadth and 1 cm. in thickness. From the shape of the specimen it is probable that the colony was a large rounded mass, and there is no evidence in favour of its having been pedunculated. It is impossible to say whether the colony was elongated from the base upwards or not, as, on account of the irregularity in the arrangement of the Ascidiozooids, it cannot be determined with certainty whether the slice was cut from the colony longitudinally or transversely.[1] The colour on the outside is simply that of the test, a warm light grey, as the Ascidiozooids are so scattered and so deeply placed in the colony as scarcely to show through at all. The large Ascidiozooids are of an opaque yellowish-brown colour, and are placed very irregularly in the test (Pl. XXIV. fig. 11). The body is nearly cylindrical and is not divided externally, but dissection shows that the branchial region occupies the anterior half or so, and the intestinal and genital parts the remainder.

The test is very compact, and has quite a cartilaginous feeling. It is of the same colour and structure throughout. The small test cells are very numerous, and in some places are densely crowded. No vessels are visible.

The mantle is not so thick as might be expected from the size and opacity of the body. The longitudinal muscle bands on the thorax are moderately strong, but they do not form a continuous layer. On the abdomen they become much thinner and gradually die away. The branchial siphon has six lobes, and the sphincter is well developed.

There are about twenty rows of stigmata in a large sized branchial sac, and there are usually about twelve in each row. The stigmata vary considerably in size in different sacs (see Pl. XXIV. figs. 12, 13, *sg.*), probably to a great extent according to the size and age of the Ascidiozooids. Figure 12 shows an average sized set of stigmata, while figure 13 was probably taken from a very young branchial sac. The endostyle is large and conspicuous, and has an undulating course.

The languets are tentacular in form, but very short (Pl. XXIV. fig. 14, *l.*) and rather closely placed. They are united by a distinct membrane (the dorsal lamina, Pl. XXIV. fig. 14, *d.l.*), behind which is placed a band of muscle fibres (*m.f.*).

The alimentary canal forms a long narrow loop. The stomach is long and has its thick wall folded transversely as in *Atopogaster aurantiaca*. The intestine is rather narrow, and undulates considerably in its course.

[1] I am inclined to think that it must have been a slightly oblique longitudinal section. If so, the colony would probably have been about 10 cm. in length and 4 cm. in breadth.

The reproductive organs occupy the post-abdomen, the region of the body behind the in testinalloop, and also encroach upon the abdomen. The usual median membranous septum is present in the post-abdomen. The ova and the spermatic vesicles occur together, and tailed larvæ were found in the peribranchial cavity of one Ascidiozooid. The larvæ (see Pl. XXIV. fig. 15) have two pigmented sense-organs placed far back in the body, and the tail has a very broad membranous margin.

Atopogaster elongata, n. sp. (Pl. XXIV. figs. 1–8).

The Colony is of an irregularly elongated form, attached by the one end, and more or less pointed at the other. It is usually somewhat compressed laterally, but may be almost cylindrical. The surface is uneven and moderately smooth. The general colour is a pale grey, but it varies in different specimens from brownish to almost white.

The length is about 10 cm., the greatest breadth 2·5 cm., and the thickness about 1 cm.

The Ascidiozooids are small, and are arranged quite irregularly. They are very numerous, and their anterior ends are closely placed all over the outer surface. The usual length of the Ascidiozooid is about 4 mm., while the greatest width is 0·4 mm. The body is not distinctly divided into regions.

The Test is compact and firm, and almost quite opaque. The matrix is homogeneous or very slightly fibrillated. The test cells are very numerous, and are generally of an elongated fusiform shape. There are no vessels and no bladder cells present in the test.

The Mantle is moderately strong. The muscle bands run mainly in a longitudinal direction; they are closely placed on the post-abdomen.

The Branchial Sac is of small size and its walls are opaque. The transverse vessels are relatively large, while the stigmata are variable in size; sometimes they are small and inconspicuous, while in other cases they are of moderate size.

The Tentacles are fairly large; they are closely placed and of different lengths.

Locality.—Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8 F.

A large number of specimens of this species were obtained by the trawl at Station 313 in the Strait of Magellan. They differ from one another considerably in shape and size (see Pl. XXIV. figs. 1, 2, 3), but the colony is always of elongated form, attached by one end, and usually tapering slightly towards the other. In some cases the colony is twisted, the upper half or one-third being bent round so as to point towards the base of attachment (Pl. XXIV. fig. 3). The colony apparently never branches. In some cases there is considerable lateral compression, the thickness being much less than the breadth, but in other cases (or even other parts of the same specimen) the shape is

nearly cylindrical. The largest colony in the collection measures about 12 cm. in length, and the smallest 1·5 cm. in length and 8 mm. in greatest breadth.

The lower ends of the colonies have evidently been imbedded in gravel and sand, as they have masses of small stones and dark coloured sand-grains attached to the test for a distance of from 1 to 3 cm. above the base. In some few cases parts of the colony further up on one of the sides also show sand-grains imbedded in the test (Pl. XXIV. fig. 3), as if these colonies had grown in a recumbent in place of an erect position. The colour is generally of a dull pale yellowish-grey. It always becomes darker towards the base of attachment, and in a few specimens it is decidedly more of a yellowish-brown tint.

The Ascidiozooids are very numerous, but small. The thorax only occupies about one-fifth of the body, and the abdomen scarcely so much, while the rest is formed by the post-abdomen (see Pl. XXIV. fig. 4). The widest part is the thorax. There are no systems, and the Ascidiozooids seem to be crowded together without any regularity.

The test is firm and opaque except in thin slices. Its outer layer is rather tougher than the central mass, and the surface is slightly uneven, the anterior ends of the closely placed Ascidiozooids forming a number of small elevations. In its minute structure the test is remarkable on account of the immense abundance of the small cells, and of their fusiform shape (see Pl. XXIV. fig. 5, *t.c.*). In some places they are greatly elongated so as almost to form fibres, and they generally lie with their long axes parallel, so as to give the test in sections a somewhat striated or fibrillated appearance.

The mantle is, relatively to the size of the Ascidiozooid, moderately strong. The longitudinal muscle bands, which are rather distant on the thorax, become much more closely placed on the post-abdomen, where they form a strong muscular investment. The sphincter at the branchial aperture is well developed.

The branchial sac is relatively small and rather feebly developed. The stigmata are usually neither large nor very numerous. In some sacs, however (Pl. XXIV. fig. 6, *sg.*), they are of fair size and are wider than the fine longitudinal vessels. The ciliated cells are pointed. The endostyle is very wide and has an undulating course. The tentacles are irregular in length.

The alimentary canal does not extend very far behind the branchial sac. The œsophagus is short and narrow, and runs directly backwards (Pl. XXIV. fig. 7, *œ*). The stomach is large and more or less globular in form. It is rather wider anteriorly than posteriorly, and the wall is thrown into irregular transverse folds. The intestine is narrow. After leaving the posterior end of the stomach it runs backward for a short distance and then turns dorsally and anteriorly to form the rectum, which, after passing the stomach and œsophagus, ends in the peribranchial cavity.

The post-abdomen is large (see Pl. XXIV. fig. 4, *p.ab.*), usually about twice as long as the thorax and abdomen together, and it is wider than is usual amongst allied

forms. A few small ova may be found near its upper end in some Ascidiozooids, but the greater part of it is occupied by a mass of young and undeveloped spermatic vesicles. The vas deferens is not conspicuous, but may generally be made out running through the upper part of the post-abdomen and continued forwards alongside the rectum. No larvæ were found in any of the Ascidiozooids examined.

The posterior end of the post-abdomen (Pl. XXIV. fig. 4) forms a slightly swollen clear-walled bulb in which the heart lies, and it presents terminally a small knob which resembles a very rudimentary vascular appendage. The double septum traversing the post-abdomen is more conspicuous than usual (Pl. XXIV. fig. 4, *p.ab.*), and transverse sections show that its lumen is complicated and that its walls are formed in most places of large columnar cells (Pl. XXIV. fig. 8). The figure shows the ectoderm externally formed of squamous cells (*ec.*), and enclosing a great mass of rounded mesoderm cells (*mes.*) in which two cavities (*cœl.*) occur, one on each side of the median double septum, which is formed of columnar endoderm cells (*end.*) bounding a narrow lumen (*ar.*), which is, according to Kowalevsky, a prolongation of the posterior end of the branchial sac.

Atopogaster elongata, var. *pallida*, nov. (Pl. XXIV. figs. 9, 10).

The Colony is an irregular mass growing upwards from a broad base of attachment. It is rather elongated from the base upwards, and tapers slightly. The upper end is blunt. The colour is a pale opaque-grey. The surface is very uneven, being cut up by deep grooves and ridges.

The length is 6·5 cm., the greatest breadth (above the base) is 3 cm., and the usual thickness is 2 cm.

The Ascidiozooids are small but very numerous, and are arranged quite irregularly. Their anterior ends are more opaque than the surrounding test, and appear as small dull yellow rounded spots. They are not distinctly divided into regions.

The Test is firm and massive, and is almost quite opaque. The small cells are exceedingly numerous; most of them are more or less rounded in form.

The Mantle is moderately strong, and most of the muscle bands run longitudinally.

The Branchial Sac is small and opaque. The stigmata are small rounded apertures.

Locality.—Simon's Bay; depth, 10 to 20 fathoms.

The specimen obtained at Simon's Bay, from which the preceding description has been taken, is very closely allied to *Atopogaster elongata*, and it is probably best to regard it as a variety of that species. The shape although still elongated from the base upwards is more irregular, the surface being strongly ridged and grooved (Pl. XXIV. fig. 9),

and the base is wide and spreading. This last character, however, is probably due to the circumstance that the colony is attached to a fragment of a large *Balanus* instead of being imbedded in the sand. The colour is much paler than in *Atopogaster elongata*, the test being of a dull whitish-grey, upon which the Ascidiozooids show as opaque yellowish-grey spots. The surface although uneven is in some places very smooth and glistening. The Ascidiozooids are small and numerous, and are scattered irregularly over the surface just as in the case of *Atopogaster elongata*. They are more numerous at the upper end of the colony than near the base of attachment, and this causes a slight difference in appearance; the lower part being greyer in colour.

The Ascidiozooids are elongated antero-posteriorly, are usually about 3 or 4 mm. in length, and are not clearly divided into regions. The widest part is about one-fourth of the way back, and the post-abdomen occupies the greater part of the body and is of considerable thickness. The whole body is quite opaque.

The test cells are rather large (Pl. XXIV. fig. 10, *t.c.*), and have usually a granular appearance. The opacity of the test is probably due in great part to the abundance of these cells. The shape of the cells, which are ovate or rounded, is quite different from that of the test cells in *Atopogaster elongata*, where the elongated fusiform cells give a characteristic appearance to sections of the test (compare Pl. XXIV. fig. 5 with Pl. XXIV. fig. 10).

The mantle is very like that of *Atopogaster elongata*. There are usually three or four muscle fibres in each of the longitudinal bands.

The branchial sac is rather smaller and the stigmata more rudimentary than in the case of *Atopogaster elongata*. The alimentary canal forms a short loop.

In other respects this variety appears to agree closely with the specimens of the species from Station 313.

Morchellioides, n. gen.

Colony massive, sessile.
Systems compound, inconspicuous.
Ascidiozooids elongated, but not distinctly divided into regions. Branchial aperture eight-lobed.
Test gelatinous.
Branchial Sac large and well developed.
Alimentary Canal large. Wall of stomach irregularly thickened.
Post-Abdomen large, but not distinctly separated from the abdomen.

The species for which this section is proposed agrees with the genera *Morchellium*, Giard, *Synoicum*, Phipps, and *Sidnyum*, Savigny, in having the wall of the stomach

areolated or thickened irregularly so as to form a series of knobs or very short cæca; but it differs from all of these groups in having the branchial aperture surrounded by eight lobes in place of six. This last feature it possesses in common with Giard's two genera *Circinalium* and *Fragarium*, from both of which it is separated by the structure of the stomach-wall. Amongst those genera with areolated stomachs (see Table, p. 152) *Morchellioides* is most nearly related to *Morchellium* on account of the compound systems and the sessile post-abdomen; and amongst genera with more than six lobes round the branchial aperture it is most nearly related to *Fragarium*, again, on account of the compound systems. Consequently the nearest allies of the present genus appear to be:—on the one side *Morchellium*, with only six lobes round the branchial aperture, and on the other *Fragarium*, with a folded or ridged stomach-wall.

The genus *Parascidia* was founded by Milne-Edwards for the reception of forms allied to *Amaroucium*, but having eight-lobed branchial apertures, and Alder very properly referred to that genus the species described by Fleming and Forbes under the name of *Sidnyum turbinatum* along with a species of his own, all of them being characterised by eight-lobed branchial apertures. *Parascidia* must be very closely related to *Fragarium*, *Circinalium*, and *Morchellioides*, but unfortunately none of the published accounts of it are sufficiently detailed to show whether or not it is distinct from all of them. *Morchellioides* can be separated from *Fragarium* and *Circinalium*, but may possibly be the same as *Parascidia*.

Further points in the structure of the present genus will be found noted under the description of the single species which follows.

Morchellioides affinis, n. sp. (Pl. XXIV. figs. 16–20).

The Colony is an irregularly globular or dome-shaped mass attached by a wide base and slightly compressed laterally. The widest part is a little way above the base, and the top is rounded. The surface is even, but finely roughened all over. The colour is a warm yellowish-grey.

The length is 4 cm., the greatest breadth is 3 cm., and the thickness is about 2·5 cm.

The Ascidiozooids are numerous and fairly large. They are very distinctly visible all over the colony, and are not arranged in regular systems. They are usually about 7 mm. in length and 1 mm. in breadth, and the body is not distinctly divided into regions externally. The widest part of the body is in the branchial region. Vascular appendages are given off from the posterior end of the body.

The Test is thick and moderately firm. It is of a light grey colour and is semi-transparent. The test cells are small but very numerous. There are no bladder cells and no pigment corpuscles, but a few rather narrow vessels are present; they end in slightly dilated knobs.

The Mantle is rather delicate. The muscle bands are all longitudinal in direction; they are narrow and not numerous.

The Branchial Sac is large and well developed. The transverse vessels are all of the same size. The stigmata are large and regular.

The Dorsal Lamina is represented by a series of large languets.

The Tentacles are of fair size. There are about a dozen of them, all of much the same length.

The Alimentary Canal is rather large. The stomach has its wall irregularly thickened, and the rectum is very wide.

The Post-Abdomen is long and narrow. Its posterior end is prolonged into several ectodermal appendages with slightly dilated ends.

Locality.—Kerguelen Island; depth, 10 to 60 fathoms.

This species in general appearance is very similar to *Amaroucium variabile,* but differs from it in the structure of the stomach-wall and in having eight lobes round the branchial aperture. It is also related to *Morchellium giardi* and to *Fragarium elegans,* Giard.

There are two colonies in the collection, both from Kerguelen Island, 10 to 60 fathoms. They are large rounded lumps (Pl. XXIV. fig. 16) with no peduncles, and having a more regular form than most of the specimens of *Amaroucium variabile* from the same locality have; otherwise they resemble that species. The dimensions of the larger colony are given above; the smaller one measures 3 cm. in length, 2·5 cm. in greatest breadth, and 1·5 cm. in thickness. Several common cloacal apertures can be made out on the surface of each colony. There are no very obvious systems, but the Ascidiozooids, though scattered all over the surface, seem to be arranged along the borders of meandering lines radiating from the common cloacal apertures (Pl. XXIV. fig. 16). The anterior ends of the Ascidiozooids show as opaque pale yellow circular spots upon the grey test. They give a yellowish tinge to the colony as a whole.

The Ascidiozooids are fairly large, and the thorax is relatively of larger size than is usual in the Polyclinidæ. The posterior part of this region is considerably wider than any other part of the body. There is no marked constriction where the thorax joins the abdomen or where the abdomen joins the post-abdomen.

Considering its mass, the test is not very solid. The minute test cells present the usual variety of shapes; they are very abundant. The vessels are small and rarely met with, as they do not extend far from the posterior ends of the Ascidiozooids. They terminate in slight bulbs (Pl. XXIV. fig. 17, *t.k.*).

The mantle is weak considering the size of the body. The atrial aperture is provided with a very long tapering atrial languet. The branchial aperture is provided with eight regular and very prominent rounded lobes (Pl. XXIV. fig 19, *br.l.*). It

is rather remarkable that this form, so closely allied to other species of the Polyclinidæ, should differ from them in the number of lobes surrounding the branchial aperture, a feature which is in most Ascidians a diagnostic character of great importance and constancy.

The branchial sac is of considerable length, and may have as many as fourteen rows of stigmata upon each side. In most cases the anterior half of the sac is narrower than the posterior, and the stigmata in the wider part are rather larger than elsewhere. There are as many as eighteen stigmata in the larger rows, and they are usually wider than the fine longitudinal vessels between them. The transverse vessels are provided with muscle fibres, and are usually very regular and uniform, but in one sac I found a transverse vessel bifurcating (Pl. XXIV. fig. 18) so as to produce a new row of stigmata, a condition frequently seen in some Simple Ascidians, but exceedingly rare amongst Compound Ascidians. The ciliated cells bounding the stigmata are large and distinct.

The endostyle is large. The dorsal languets are tentacular in shape and rather blunt.

The œsophagus is a gradually widening tube which leads from the posterior end of the branchial sac directly backwards to the large stomach (Pl. XXIV. fig. 20, *œ.*). The stomach is irregularly pear-shaped, and its wall in place of being thrown into ridges as in *Amaroucium variabile* and other allied forms, is raised into a series of knobs projecting from the surface, on which the epithelium is greatly thickened. These knobs are placed in irregular rows extending antero-posteriorly along the stomach (Pl. XXIV. fig. 20, *cœ.*). There can be no doubt that this peculiar condition is simply the result of the breaking up of the longitudinal folds or ridges so common in the stomachs of Compound Ascidians into rows of detached knobs. The intestine extends for a considerable distance beyond the stomach and then turns sharply towards the dorsal side and anteriorly, to form a very narrow loop. It then becomes the thin-walled wide rectum, which runs forwards along the dorsal edge of the abdomen and thorax. The post-abdomen varies considerably in size, usually it is rather narrow. Its prolongation to form ectodermal tubes or vessels which branch through the test (Pl. XXIV. fig. 17, *v.ap.*) is remarkable, since it is a condition very rarely seen in the Polyclinidæ.

Reproductive organs were not developed in many of the Ascidiozooids examined. When they are present, the vas deferens is large and conspicuous. Its course is very undulating.

Morchellium, Giard.

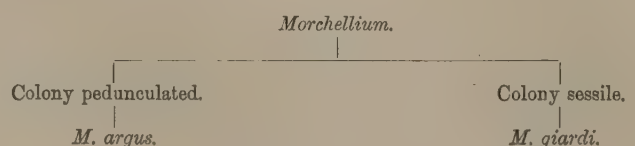
Amaroucium, Milne-Edwards, Observations, &c., 1842 (in part).
Morchellium, Giard, Recherches sur les Ascidies composées ou Synascidies, Archives d. Zool. expér., &c., vol. i. p. 641, 1872 (as a subgenus).

Colony massive, sessile, or pedunculated.
Systems compound, irregular, and usually inconspicuous.
Ascidiozooids elongated but not distinctly divided into regions. Branchial aperture six-lobed.
Test gelatinous or cartilaginous.
Branchial Sac large and well developed.
Alimentary Canal usually large. Wall of stomach irregularly thickened.
Post-Abdomen large, but not distinctly separated from the abdomen.

This group was formed as a subgenus of *Aplidium* by Giard in 1872 for the reception of a single species, *Morchellium argus*, the *Amaroucium argus* of Milne-Edwards. It was characterised by the long, sessile post-abdomen, the compound irregular systems, and the areolated stomach. The last feature is an important one which this genus shares along with *Sidnyum*, *Synoicum*, and *Morchellioides*. From the first of these forms *Morchellium* is distinguished by its post-abdomen not being separated from the abdomen by any constriction, while it differs from the second in having compound irregular systems. *Morchellioides* is separated from all of these by having eight lobes round the branchial aperture.

The condition of the stomach-wall in these four genera is very interesting. In place of being thrown into longitudinal or transverse folds it is irregularly thickened, the result being the production of a series of knobs or very short cæca projecting outwards (see Pl. XXV. fig. 3). In the case of *Morchellioides affinis* these cæca form a system of irregular longitudinal lines suggesting that the areolated condition is the result of the breaking up of a series of longitudinal folds; while in *Morchellium giardi* and *Sidnyum pallidum* they are more irregularly placed.

No species have been added to the genus *Morchellium* since it was instituted by Giard in 1872, and the new species described below belongs to the southern hemisphere, and differs very considerably in structure from the type species. The genus may be divided as follows:—



Morchellium giardi, n. sp. (Pl. XXV. figs. 1–3).

The Colony is of rudely hemispherical form and is attached by a small area in the centre of the lower surface. The upper surface is broad and convex, the lower is smaller and usually flattened or slightly concave. There is no lateral compression. The surface is even but not smooth. The colour is a dull pale brown.

The length is 1·8 cm., the breadth 2·5 cm., and the thickness 2 cm.

The Ascidiozooids are of moderate size and fairly numerous. They are placed vertically in the colony and are arranged in systems around the common cloacal apertures, of which there are a good number on the upper surface of the colony. The body of the Ascidiozooid is usually about 5 mm. or 6 mm. in length and 1 mm. in breadth; it is not distinctly divided into regions.

The Test is firm and cartilaginous. It is of a greyish-brown colour and is rather opaque. The test cells are small but very numerous. Most of them are fusiform or branched, and their protoplasm is granular. No bladder cells are present.

The Mantle is thin and transparent and not very muscular. The longitudinal muscle bands are fairly strong, but are placed far apart.

The Branchial Sac is large and well developed. The transverse vessels are numerous and all of the same size. The stigmata are long and narrow and arranged with great regularity.

The Dorsal Lamina is represented by a series of large languets.

The Tentacles are numerous and closely placed.

The Alimentary Canal forms a long narrow loop. The stomach has its wall irregularly thickened.

The Post-Abdomen is large and quite opaque.

Locality.—Royal Sound, Kerguelen Island, January 19, 1874; depth, 20 to 60 fathoms.

Four specimens of this species were obtained in Royal Sound, Kerguelen Island. They are all of rounded form, flattened from above downwards so as to present a somewhat hemispherical appearance in side view (Pl. XXV. fig. 1). The place of attachment is sessile, and usually occupies the middle third or so of the flattened lower surface. The colour is characteristic. It is a dull brown with a slight olive-green shade. A few sand-grains are found adhering to the surface in different parts of the colony, even on the upper surface.

The largest specimen is nearly 3 cm. in its greatest extent (breadth), and the smallest is 1·3 cm. in length, 1·9 cm. in breadth, and 1·5 cm. in thickness. There are a considerable number of systems in each colony. Fifteen common cloacal apertures are visible on the upper surface of one colony and twelve on another. They are small, circular or

elliptical in outline, and have the Ascidiozooids arranged in a circle around them (Pl. XXV. fig. 1), consequently the systems resemble those of the genus *Botryllus* in outline. Parasitic Crustaceans were found in some of the cloacal cavities. The anterior ends of the Ascidiozooids are seen on the upper surface of the colony as small round spots, and the bodies are visible on the sides of the colony in the form of pale yellow streaks. In sections the Ascidiozooids are seen to be equally numerous in all parts of the colony.

The test is very tough and solid, and is of the same colour and consistence throughout. In some places the matrix is delicately fibrillated. The test cells are more abundant in the outer layer than elsewhere; they are mostly fusiform, and are arranged with their long axis parallel to the surface. They are nearly all granular and opaque, while the surrounding matrix is clear and transparent.

The longitudinal muscle bands in the mantle are very regular, but narrow; on the post-abdomen they are less regular; they are broader, but placed further apart, on the thorax; and are almost absent on the abdomen. The branchial aperture is six-lobed. The branchial siphon is long and narrow, and the sphincter is well developed. In some parts of the thorax the muscle bands are rather irregular in their arrangement and anastomose with one another.

There are about twelve rows of stigmata in the branchial sac. The transverse vessels are strong, and are provided with double muscle bands (Pl. XXV. fig. 2, *m.f.*). The anterior band of one vessel is connected at the dorsal and ventral edges with the posterior band of the vessel in front, and the posterior band of the first vessel is connected at the edges with the anterior band of the vessel behind, so that a continuous band of muscle fibres encircles each row of stigmata (see Pl. XXV. fig. 2). The effect of the contraction of these muscles of the branchial sac would probably be to corrugate the stigmata and interstigmatic vessels and so diminish the size of the sac as a whole. Probably this action takes place when the mantle contracts and water is forced out through the branchial and atrial apertures simultaneously. The stigmata are usually equal in breadth to the fine longitudinal vessels. The ciliated cells are large and distinct.

The dorsal languets are large and of an elongated triangular form. They are numerous and closely placed. The endostyle is large and conspicuous. The tentacles are of two sizes placed alternately; they are large. The nerve ganglion is ellipsoidal in shape and of large size.

The œsophagus is of moderate length and runs directly backwards to open into the large ellipsoidal stomach (Pl. XXV. fig. 3). The wall of the stomach is folded so as to form a number of detached knobs with thickened epithelium projecting from the surface. This structure recalls the condition of the stomach in *Morchellioides affinis*, but in the present case the knobs or cæca are more numerous and are less distinctly placed in rows (Pl. XXV. fig. 3, *st.*). In a transverse section of the stomach

there are generally from fifteen to twenty visible. The intestine runs posteriorly from the stomach for some distance (Pl. XXV. fig. 3, *i.*), and then turns abruptly towards the dorsal edge, and then anteriorly, so as to form a narrow loop. The rectum is wide and rather thin walled.

The post-abdomen is nearly as wide as the abdomen, but is not very long. In transverse sections it shows the usual double median septum with a slit-like lumen and the two lateral cavities surrounded by masses of opaque granular cells. A few young ova were seen in the anterior part of one post-abdomen, but the reproductive organs seemed to be in an undeveloped condition in the other Ascidiozooids examined.

Sidnyum, Savigny.

Sidnyum, Savigny, Mémoires, &c., addition, p. 238, 1816.
Sidnyum, Giard, Recherches, &c., Archives d. Zool. expér., vol. i. p. 635, 1872.
non *Sydneum*, Fleming, British Animals, p. 469, 1828.
non *Sidnyum*, Alder, Trans. Tyneside Naturalists' Field Club, vol. i. p. 109, 1848.
non *Sidnyum*, Forbes, British Mollusca, vol. i. p. 13, and vol. ii. p. 369, 1853.

Colony massive, or formed of a number of lobes, one corresponding to each system.
Systems compound.
Ascidiozooids elongated and distinctly divided into regions; branchial aperture six-lobed; atrial aperture not provided with a languet.
Test gelatinous.
Branchial Sac well developed.
Alimentary Canal forming a narrow loop. Stomach-wall irregularly thickened.
Post-Abdomen long, and separated from the abdomen by a constriction.

This genus was formed by Savigny for a species which he briefly described in an appendix to his "Mémoires," published in 1816. The specimen, which he named *Sidnyum turbinatum*, had been found in British Seas by Leach and sent by him to Savigny. Its characteristics led Savigny to place it between *Synoicum*, Phipps, and his own genus *Aplidium*. He pointed out the similarity in the structure of the stomach-wall existing between *Sidnyum* and *Synoicum*, and described the post-abdomen as pedunculated, a point in which the two genera differ. Giard in his classification of the Polyclinidæ recognised *Sidnyum*, but was apparently unable to decide whether it belonged to the genus *Aplidium* or the genus *Polyclinum* of his system.

The new species which is described below, although agreeing in all essential characters with Savigny's *Sidnyum turbinatum*, differs greatly in external appearance, and the two forms may therefore be readily distinguished. *Sidnyum pallidum* forms a globular mass with a broad and rounded upper surface (Pl. XXV. fig. 4), while in *Sidnyum*

turbinatum each system forms a separate lobe in the form of a truncated cone projecting from the surface of the colony.

The specimens described as *Sidnyum turbinatum* by Professor E. Forbes[1] and by Dr. Fleming[2] are, according to Alder,[3] not that species, but belong to a separate but allied genus *Parascidia*, Milne-Edwards, characterised by an eight-lobed branchial aperture. Alder named them *Parascidia forbesii* and *Parascidia flemingii*, and described a third species *Parascidia flabellata*.

Sidnyum pallidum, n. sp. (Pl. XXV. figs. 4–6).

The Colony is of irregularly globular form, and is attached by a small area at the lower end. The upper surface of the colony is broad and rounded. There is no lateral compression. The surface is moderately even but not smooth. The colour is a pale but dull grey.

The length is 1·5 cm., the breadth is 1·7 cm., and the thickness is 1·4 cm.

The Ascidiozooids are of moderate size and fairly numerous; they are arranged in systems around the common cloacal apertures, which are small but distinct. The body of the Ascidiozooid is long and narrow, being usually about 8 or 9 mm. in length and less than 1 mm. in breadth. It is of a very pale yellow colour and semi-transparent. The three regions of the body are clearly distinguishable.

The Test is soft and flexible. It is of a light grey colour and is transparent. The test cells are small but numerous. There are no bladder cells present.

The Mantle is thin and transparent. The musculature is feeble. The muscle bands are all longitudinal in direction; they are narrow and not closely placed.

The Branchial Sac is well developed. There are about twelve transverse vessels, all of the same size. The stigmata are small but well formed, and are regularly arranged.

The Dorsal Lamina is represented by a series of short stout languets.

The Alimentary Canal is relatively very long, and forms a narrow loop. The stomach is globular and has its wall irregularly thickened.

The Post-Abdomen is long and less opaque than usual. It contains both male and female reproductive organs.

Locality.—Off Marion Island, depth 50 to 75 fathoms.

This species, although it resembles *Morchellium giardi* in some respects, is quite distinct from that and all previously described species both in external appearance and internal

[1] British Mollusca, vol. i. p. 13, 1853.

[2] British Animals, p. 469, 1828. The specimen was found by Dr. Fleming on the shores of the Isle of May in the Firth of Forth.

[3] *Ann. and Mag. Nat. Hist.*, ser. 3, vol. xi. p. 152, 1863.

structure. Two colonies of about the same size were obtained near Marion Island, between the Cape of Good Hope and Kerguelen Island, in from 50 to 75 fathoms of water.

There is no peduncle, the pale grey rounded mass being simply attached by a small portion of its surface (Pl. XXV. fig. 4). The colour may become darker in places from the presence of small patches of minute sand-grains adhering to the surface. The systems are clearly visible on the upper part of the colony, as the anterior ends of the Ascidiozooids show through the transparent test very distinctly. The bodies are unusually elongated. A specimen 9 mm. in length has the thorax 2·5 mm. in length, the abdomen 2·5 mm., and the post-abdomen 4 mm. The thorax is the widest part (Pl. XXV. fig. 6, *th.*).

The outer layer of the test is rather firmer than the inner part. The test cells are mostly of rounded form, though some are stellate or branched. The protoplasm of these cells is generally coarsely granular.

The muscle bands in the mantle are all delicate, and on the abdomen and post-abdomen they are particularly narrow. The branchial siphon is short, and the sphincter muscle is not well developed. The branchial aperture is obscurely six-lobed. The atrial aperture is placed at the end of a siphon and is six-lobed. No atrial languet is present.

Thebranchial sac is rather like that of *Morchellium giardi* (compare figs. 2 and 5 on Pl. XXV.). The transverse vessels are moderately wide (Pl. XXV. fig. 5, *tr.*), and are provided with muscle bands having the arrangement around the rows of stigmata at the dorsal and ventral edges which is described on p. 182 (see Pl. XXV. fig. 2, *m.f.*). The stigmata are equal in width to the fine longitudinal vessels. The dorsal languets are broader and very much shorter than those of *Morchellium giardi*. The endostyle is conspicuous, its course is undulating.

The œsophagus is a long narrow curved tube with the convexity dorsal (Pl. XXV. fig. 6, *œ.*). It enters the stomach on its outer or dorsal edge about half way down. The stomach is nearly globular in shape, and has its wall thickened irregularly so as to form a number of short cæcal processes like those seen in the case of *Morchellioides affinis* and *Morchellium giardi*. The cæca are not arranged in rows (Pl. XXV. fig. 6, *st.*). The intestine is at first a wide tube. It runs directly backwards from the posterior end of the stomach for a short distance, and then turns ventrally and towards the right hand side to become the rectum; the intestinal loop is very narrow, and the most posterior part of the intestine is of small calibre. The rectum is a large thin-walled tube. It runs forward on the ventral and right hand edge of the stomach, and then turns dorsally, crossing on the right hand side of the œsophagus. It runs for a short distance along the dorsal edge of the thorax, and then terminates by opening into the peribranchial cavity.

The post-abdomen is separated from the rest of the body by a slight constriction. The reproductive organs in all the Ascidiozooids examined occupied only a small portion

of the post-abdomen, and the remainder was much less opaque than usual. The ova are found in a small group, usually placed near the anterior end (see Pl. XXV. fig. 6, *o.*), and are united by narrow tubular pedicels.

The spermatic vesicles are pyriform and of small size. The vas deferens is narrow but distinct, and may be traced from the post-abdomen forwards through the abdomen and thorax, where it lies alongside the rectum (see Pl. XXV. fig. 6, *v.d.*).

Polyclinum, Savigny.

Polyclinum, Savigny, Mémoires, 1816.
Polyclinum, Milne-Edwards, Observations, &c., 1842.
Polyclinum, Forbes, British Mollusca, vol. i. p. 14, 1853.
Polyclinum, Giard, Recherches, &c., Archives de Zool. expér., vol. i. p. 641, 1872.
Polyclinum, von Drasche, Die Synascidien, 1883.

Colony massive, usually sessile.
Systems simple or compound, often irregular.
Ascidiozooids elongated, more or less distinctly divided into three regions; branchial aperture six-lobed; atrial aperture provided with a languet.
Test gelatinous or cartilaginous, sometimes incrusted with sand.
Branchial Sac large and well developed.
Alimentary Canal usually long and complicated, often twisted; stomach smooth walled.
Post-Abdomen separated from the abdomen by a distinct constriction, often projecting from one side of the intestinal loop.

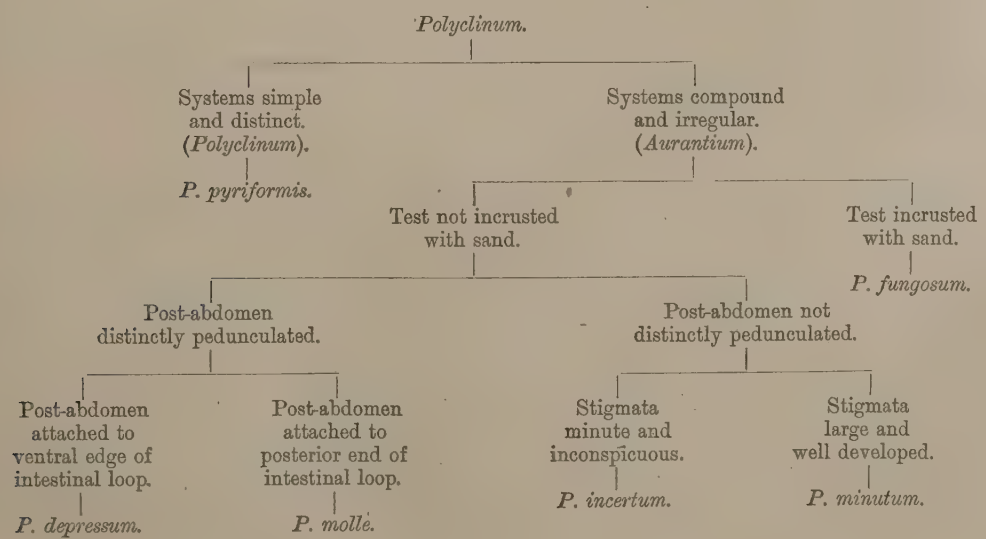
Savigny in characterising this genus laid stress upon the distinct but often irregular systems, each provided with a common cloaca, the six lobes of the branchial aperture and the well-developed atrial languet, the large branchial sac, and the distinct division of the body of the Ascidiozooid into three regions. These characters, however, are not sufficient to distinguish the genus from some of the other Polyclinidæ, and consequently subsequent authors have added to and modified them considerably. Giard pointed out that in many species of *Polyclinum* the alimentary canal is so twisted that the rectum crosses over the right side of the stomach. He considered this disposition of the intestinal loop as the most important character of the genus, and one which distinguished it from all the other Polyclinidæ. Von Drasche, however, found it necessary to modify Giard's definition slightly, so that *Polyclinum* might include forms where the alimentary canal was so placed that the stomach lay not on the left side of, but anteriorly to, a part of the rectum. I have met with both of these arrangements and also with others which seem to show a gradual transition between the twisted condition found in Savigny's species[1]

[1] See his Mémoires, pls. xviii. and xix.

and the simple loop characteristic of *Aplidium* and *Amaroucium*. Consequently I question the great value of the intestinal twist as a diagnostic character, and I feel inclined rather to put my trust in a combination of characters, which are:—The separation of thorax, abdomen, and post-abdomen, and the somewhat lateral position of the latter, the twisting of the intestine, and the smooth-walled stomach. In regard to the last-named character, on which I would lay some stress, Savigny figures a perfectly smooth stomach in all his species of *Polyclinum*, and all the species which I have examined, and which seem to me to belong to this genus, have the stomach-wall smooth and free from all folds or irregular thickenings, an unusual condition in the Polyclinidæ. Consequently I have come to consider this simple type of stomach as one of the most important if not the primary characteristic of the genus *Polyclinum*.

Giard subdivided the genus, according to the condition of the systems, into (1) *Aurantium*, in which they are compound, and (2) *Polyclinum* proper, in which they are simple. According to this classification, all of the Challenger species, with the exception of *Polyclinum pyriformis*, would probably be placed under *Aurantium*, but, as it is exceedingly difficult, if not indeed impossible in some cases, to determine with certainty the condition of the systems in specimens preserved in alcohol, I have considered it best for the present to regard *Polyclinum* and *Aurantium* as forming one group. When the species described below come to be examined afterwards in the living condition, those of them with compound and irregular systems can, if their investigator confirms my suspicions as to their condition, be transferred to the genus *Aurantium*, leaving *Polyclinum pyriformis* as the sole representative of *Polyclinum* in the Challenger collection.

The new species may be distinguished by the following characters:—



Polyclinum pyriformis, n. sp. (Pl. XXVI. figs. 1–4).

The Colony is pyriform and is attached by a short stalk formed by a prolongation of the narrower end of the colony. The upper end is wide and rounded. There is little or no lateral compression. The surface is regular and smooth. The colour is a light greyish-yellow.

The length is 3 cm. (of which 8 mm. is formed by the stalk), the breadth is 2·2 cm., and the thickness is about 1·7 cm.

The Ascidiozooids are large and very numerous; they are arranged in systems around the common cloacal apertures, of which there are several on the upper surface of the colony. The Ascidiozooid is usually about 12 mm. in length and 1·5 mm. in breadth. The body is distinctly divided into three regions.

The Test is soft and gelatinous in the upper part of the colony; it becomes firmer on the peduncle. It is of a light grey colour and very transparent. The test cells are small and not very numerous; they are usually triangular or stellate, and frequently have long branched prolongations. There are no bladder cells.

The Mantle is thin and transparent. The musculature is rather weak, and is mainly longitudinal in direction.

The Branchial Sac is large and well developed. The transverse vessels are all of the same size. The stigmata are long and narrow, and are arranged with regularity.

The Endostyle is long and narrow but conspicuous.

The Dorsal Lamina is represented by a series of languets.

The Tentacles are large and closely placed; there are about twelve of them, all of the same size.

The Alimentary Canal forms a short wide loop. The stomach is large and its wall is smooth.

The Post-Abdomen is long but narrow.

Locality.—Kerguelen Island; depth, 10 to 60 fathoms.

This species has a certain external resemblance to *Amaroucium globosum*, which was obtained at the same locality on the shores of Kerguelen Island. The two species are, however, quite distinct, although allied forms. There are two specimens of *Polyclinum pyriformis* in the collection, and both are very distinctly pear-shaped and shortly pedunculated (Pl. XXVI. fig. 1). The dimensions given in the above description are those of the large specimen. The smaller one is 2·3 cm. in length (including peduncle), 1·3 cm. in breadth, and 1·1 cm. in greatest thickness.

The yellow colour of this species is due mainly to the abundance of the Ascidiozooids, which are of an opaque yellow colour and very distinctly visible through the transparent test. The Ascidiozooids are arranged in fairly regular circular systems (Pl. XXVI.

fig. 1). The common cloacal apertures are circular, and vary from 1 mm. to 2 mm. in diameter. There are usually about eight Ascidiozooids in a system. On the upper surface of the colony the wide anterior ends of the Ascidiozooids are distinctly visible. They show the branchial aperture with its six lobes and the anterior extremity of the endostyle. On the sides of the colony the abdominal and post-abdominal regions are seen (Pl. XXVI. fig. 1). In a body 12 mm. long the thorax is about 4 mm. in length, the abdomen 3 mm., and the post-abdomen 5 mm. In some cases the post-abdomen is relatively much longer. It extends down to the top of the peduncle.

The test in the upper part of the colony is small in amount, as the Ascidiozooids are very closely placed (Pl. XXVI. fig. 1). The outer surface is firmer than the inner part, and can be torn off as a distinct membrane. The ectoderm adheres very firmly to the test, and consequently it is sometimes a little difficult to separate the thoracic part of the Ascidiozooid from the test, and patches of the ectoderm and even small pieces of the mantle are occasionally left adhering to the test. The mantle is unusually delicate, and recalls that of some species of *Colella* in the Distomidæ. The branchial aperture is distinctly six-lobed, but the sphincter is feebly developed (Pl. XXVI. fig. 4, *br.*).

The branchial sac is usually about 4 mm. in length and 1·5 mm. in breadth. The number of transverse vessels is usually over twelve, and the stigmata are always well developed. There is a considerable amount of variability, however, in the size of the transverse vessels and the length of the stigmata. The characters appear to be constant throughout the same sac, but differ in the Ascidiozooids of one colony. Figures 2 and 3 on Plate XXVI. show two extreme conditions. In figure 3 the transverse vessels are as wide as the length of the stigmata, while in figure 2 they are much narrower and the stigmata are larger. Each transverse vessel has a bundle of muscle fibres running along it (Pl. XXVI. fig. 2, *m.f.*). The ciliated cells bounding the stigmata are always large and distinct.

The dorsal languets are triangular, rather short, and flattened antero-posteriorly (Pl. XXVI. fig. 3, *l.*). On account of the transparency of the mantle and branchial sac the endostyle is always a conspicuous object in dissections. It is unusually narrow, and does not undulate from side to side.

The œsophagus (see Pl. XXVI. fig. 4, *œ*) is long, narrow, funnel-shaped, and curved with the convexity dorsal. It leaves the branchial sac at the dorsal edge of the posterior end. The stomach is large and ovate in shape, and its long axis is directed posteriorly and ventrally (Pl. XXVI. fig. 4, *st.*). The œsophagus joins it by a small circular aperture on its inner or dorsal edge about the junction of the anterior and middle thirds. The wall of the stomach is not folded or thickened in any part. The intestine leaves the posterior end of the stomach and curves posteriorly and dorsally, narrowing until it reaches its most posterior point (Pl. XXVI. fig. 4, *i.*), where it enlarges to form a spindle-

shaped dilatation before turning anteriorly to become the rectum. The intestine is thin walled, and it forms an open loop. The spindle-shaped dilatation and the rectum are separated by a constriction (Pl. XXVI. fig. 4, *i'*.). The rectum is wide and forms the dorsal edge of the abdomen and a considerable portion of the thorax (Pl. XXVI. fig. 4, *r*.). The anal aperture is small, with a reflected margin.

The mantle over the abdomen is considerably pigmented, especially in its posterior part, around the intestinal loop. The pigment granules are opaque white. The post-abdomen is very variable in length. It is of a dull yellow colour and is quite opaque, except along the middle line, where a narrow undulating clear streak represents the lumen of the septum.

Polyclinum fungosum, n. sp. (Pl. XIV. figs. 15–23).

The Colony has a plano-convex discoid form. It is nearly circular in outline. The lower surface is almost flat, and the point of attachment is at its centre; there is no peduncle. The upper surface is irregularly convex. The colour is a dark dull grey. The surface is uneven, and is roughened all over by a layer of small sand-grains adhering to the surface. No common cloacal apertures are visible.

The length (from the place of attachment to the highest point) is 1·6 cm., the breadth 3·3 cm., and the greatest thickness 2·8 cm.

The Ascidiozooids are very long, and are placed at right angles to the upper surface. The largest measure about 8 mm. in antero-posterior extent and about 2 mm. in greatest breadth. The anterior end is not wide. It forms a small projection on the surface of the colony about 1 mm. in diameter.

The Test is soft but fairly firm. The outer layer is strengthened by imbedded and attached sand-grains and shell fragments. It is quite opaque and of a dull grey colour. In sections of the deeper layer of test the homogeneous matrix is seen to contain many small rounded cells; the usual fusiform and stellate shapes are absent or rare. No bladder cells are present.

The Mantle is rather thin. The transverse muscle bands are fairly strong, but are placed far apart. The branchial sphincter is well developed.

The Branchial Sac is very long and narrow. The transverse vessels are all similar, and are of moderate size. They have horizontal membranes attached to their inner edges. The stigmata are long and narrow, usually with rounded ends. They are very regularly placed.

The Dorsal Lamina is formed of a series of long pointed languets.

The Tentacles are very numerous and closely placed. There are about twenty very long and thin tentacles and some intermediate smaller ones.

The Dorsal Tubercle is a rounded opening placed near the base of the tentacles. The neural duct is very large. There is no peritubercular area.

The Reproductive Organs are large; they are hermaphrodite.

Locality.—Port Jackson, Australia; depth, 6 to 15 fathoms.

This is an interesting species. From its external appearance and its essential structure, it belongs to the Polyclinidæ, but from some points in its internal anatomy it seems allied to *Colella* and the other Distomidæ. There is only one specimen in the collection. It was obtained at Port Jackson, Australia, from a depth of 6 to 15 fathoms.

In shape the colony is somewhat like a Fungus, being an irregularly discoid mass, flat below and rounded above (see Pl. XIV. fig. 16). From near the middle of the lower surface there projects a mass of mud, &c., from 1 cm. to 1·5 cm. in diameter, which indicates the point of attachment of the colony. This spot is seen in the side view (Pl. XIV. fig. 16) and still better in the vertical section (Pl. XIV. fig. 17). The rounded upper surface (Pl. XIV. fig. 15) rises from the edge on all sides, but the slope varies, as may be seen by comparing the edges in figures 16 and 17. The edge nearly all round is thickened and slightly upturned (Pl. XIV. fig. 17). The upper surface is covered all over with small rounded areas like flattened papillæ (Pl. XIV. figs. 15, 16). These are the anterior ends of the Ascidiozooids. They seem to be arranged quite irregularly, and are incrusted like the rest of the surface with adhering sand-grains. A vertical section through the colony (Pl. XIV. fig. 17) shows that the Ascidiozooids are placed very closely side by side and reduce the test to narrow bars and membranes. They are all placed vertically, and they vary greatly in size, those in the centre—the highest part of the colony—being fully 8 mm. in length, while those at the edge measure only 4 mm.

The opaque dull grey colour of the colony is due in great part to the surface layer of sand, the test below being of a much lighter grey and fairly transparent. There is really comparatively little test in this colony, the greater part of the mass being formed by the bodies of the Ascidiozooids. The test cells are notable on account of the absence of the long delicate processes so common in most other Ascidians; here they are nearly all rounded or ovate in form.

The mantle has regularly arranged transverse muscle bands which encircle the branchial part of the body, and a few smaller irregularly running bundles. The branchial siphon is small, and is distinctly six-lobed at its free end.

The branchial sac is exceedingly long and narrow. It extends along the greater part of the body of the Ascidiozooid. There are in the mature sac ten or twelve rows of stigmata upon each side, and each row contains about twelve stigmata. The transverse vessels are not narrow (Pl. XIV. fig. 18, *tr.*). The stigmata are arranged with great regularity, and are long with rounded ends. The ciliated cells are broad and low,

they are flat-topped and do not project as in the case of *Colella pedunculata* and some other species.

The endostyle is long and narrow, but conspicuous; its course is nearly straight. The languets (Pl. XIV. fig. 19, *l.*) are well developed. The tentacles are very long and thin. Their bases form a rather small circle (Pl. XIV. fig. 20) and are closely placed. There are about two dozen large tentacles and some smaller intermediate ones. The peripharyngeal band is very distinct, it does not form a peritubercular area. The mass formed by the nerve ganglion and neural gland is large and of an elliptical shape (Pl. XIV. fig. 20, *n.g.*). From its anterior end projects a very large and conspicuous neural duct with thick walls, which runs forward under the peripharyngeal band to open in the prebranchial zone, not far behind the base of the tentacles (Pl. XIV. fig. 20, *d.t.*). In all probability this very distinct neural tube really corresponds to the funnel-shaped enlargement, lined by columnar ciliated cells which is found in other forms (see *Botrylloides fulgurale*, Pl. III. fig. 8), and not to the more delicate part of the duct lying behind that.

The alimentary canal is relatively not very large. The œsophagus is a narrow tube which runs from the dorsal edge of the posterior part of the branchial sac backwards and dorsally to open into the irregularly globular stomach (Pl. XIV. fig. 21). The œsophagus does not enter at the anterior end of the stomach, but a little way back on the inner edge. The stomach is thick walled, but has no folds in its interior. At the posterior end of the stomach the intestine commences by a very narrow passage which soon expands into a somewhat quadrate thick-walled dilatation (Pl. XIV. fig. 21); from this cavity the intestine continues backwards as a wide tube which turns round ventrally and then anteriorly to become the rectum. From this point forward the tube contains a series of ovate fæcal pellets of a dark colour, which are just visible to the naked eye (Pl. XIV. fig. 21, *r*). The rectum is very long; it crosses the œsophagus, and is then continued up the dorsal edge of the branchial sac for a very considerable distance. The anus is small but has a prominent margin (Pl. XIV. fig. 21, *a.*).

The reproductive organs are large, and form an ovate mass (Pl. XIV. fig. 22) extending for a considerable distance behind the alimentary canal. They thus agree with the arrangement seen in the other Polyclinidæ, where there is always more or less of a post-abdomen developed, in which the genital glands are situated. In the development of this region of the body the present species is intermediate between *Colella* and the Distomidæ on the one hand, and most of the Polyclinidæ on the other.

The mature Ascidiozooids are hermaphrodite. Ova of various sizes and ages are found along with fully developed spermatic vesicles (Pl. XIV. fig. 22, *o.* and *t.v.*). The ova form a clump upon one side of the genital mass, while the ovate spermatic vesicles are grouped in front and at the sides, and especially behind, where they form the most posterior part of the body of the Ascidiozooid. The vas deferens is large and is always a

conspicuous object (Pl. XIV. fig. 22, *v.d.*). It branches through the genital mass, giving off a twig to each spermatic vesicle, and on leaving the mass at its anterior end attaches itself to the rectum, along which it runs anteriorly to open into the peribranchial cavity.

Tailed larvæ were found in some of the Ascidiozooids; they have ovate bodies with conspicuous sense organs placed far back (Pl. XIV. fig. 23).

Polyclinum depressum, n. sp. (Pl. XXVI. figs. 5–7).

The Colony is an irregularly discoid mass incrusted with stones and shell-fragments. The upper free surface is flattened, while the lower attached part is rather convex. The surface is very irregular, and not smooth. The colour is light grey.

The length of the colony from the base of attachment to the free surface is 1·5 cm., the greatest breadth is 5 cm., and the greatest thickness 4 cm.

The Ascidiozooids are fairly large, but few in number, and very irregularly scattered. They are usually about 5 mm. in antero-posterior length, and are distinctly composed of two parts, the anterior consisting of the thorax and abdomen, and the posterior of the long post-abdomen.

The Test is thick, but soft and gelatinous. It is of a light grey colour and is semi-transparent. The matrix is clear and structureless, and contains numerous test cells, most of which are more or less rounded in form. No bladder cells are present.

The Mantle is strong and opaque. The chief muscle bands run longitudinally and form over the greater part of the body a continuous muscular coating. The musculature on the post-abdomen is especially strong.

The Branchial Sac is of small size. The stigmata are minute and inconspicuous.

The Alimentary Canal is small, and the intestine forms a narrow loop.

The Post-Abdomen is very large. It springs from the ventral edge of the posterior end of the abdomen.

Locality.—Torres Strait, north of Australia; depth, 3 to 11 fathoms.

This species is formed for a flat incrusting colony obtained in Torres Strait, between Australia and New Guinea, from a depth of 3 to 11 fathoms. It has evidently been attached by more than half its surface to small stones, shell-fragments, and other foreign bodies, while a considerable portion of even the upper surface is incrusted with Polyzoa and Zoophytes. Where exposed the surface is irregular and roughened (Pl. XXVI. fig. 5). It does not vary in colour, being a light grey all over. No common cloacal apertures and no systems of Ascidiozooids are visible in any part of the colony.

The Ascidiozooids are of an opaque pale yellow colour, and seem to be placed very irregularly in the test: they lie at all angles to the outer surface. The abdomen is not

distinctly separated from the thorax, but the post-abdomen is conspicuous (Pl. XXVI. figs. 6, 7). The Ascidiozooids are not at all numerous, and some of them seem to be partially decayed. Possibly the colony may have been in a dying condition when it was found.

The test is singularly soft considering its thickness. The test cells are rather large, and they are very abundant. The musculature of the mantle is much stronger than is usual in the Polyclinidæ. The muscle fibres are of large size. The branchial aperture is very distinctly six-lobed (Pl. XXVI. fig. 6), and the atrial aperture is provided with a prominent languet.

The branchial sac is of quadrate form and very opaque. The endostyle is small and inconspicuous.

The abdomen differs somewhat in size in different Ascidiozooids. Figures 6 and 7 on Plate XXVI. show two specimens, in one of which (fig. 6) the intestine reaches much further beyond the branchial sac than it does in the other (fig. 7). The stomach is smooth walled.

The post-abdomen is usually three or four times as long as the combined thorax and abdomen, and about half their breadth. It is sometimes dilated at the end to form a bulb with a small terminal knob (Pl. XXVI. fig. 7). Both ova and spermatic vesicles are found in the same post-abdomen, and the large vas deferens is always a conspicuous object (Pl. XXVI. figs. 6, 7, *v.d.*), running in an irregular and convoluted course along the dorsal edge of the post-abdomen.

Polyclinum molle, n. sp. (Pl. XXV. figs. 7–9).

The Colony is an irregularly rounded mass, somewhat compressed laterally, and attached by the whole of the lower end. The upper surface is wide and convex, the lower is rather narrower and is flattened. The surface is uneven but smooth. The colour is dark grey.

The length is 2·4 cm., the breadth is 3·3 cm., and the thickness 1·5 cm.

The Ascidiozooids are of moderate size and not very numerous. They appear to be placed quite irregularly in the colony, and no systems are present. The body is from 6 to 8 mm. in length and 1·5 mm. in greatest breadth, and the three regions are clearly distinguishable.

The Test is soft and flexible. It is of a dull grey colour and moderately transparent. Large numbers of minute sand-grains are imbedded in it, especially in the outer layers. The test cells are abundant and of all shapes, most of them much branched; some of those in the outer layer are very granular. No bladder cells are present.

The Mantle is thick and opaque, but not very muscular. The chief muscle bands run longitudinally.

The Branchial Sac is not large. Its wall is thick and opaque, and considerably corrugated. The stigmata are small and inconspicuous.

The Alimentary Canal is large and quite opaque. The stomach is globular, and smooth walled.

The Post-Abdomen is moderately long, and very irregular in its thickness. It is separated from the abdomen by a marked constriction.

Locality.—Station 320, February 14, 1876 ; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms ; bottom, green sand ; bottom temperature, 37°·2 F.

One specimen of this species was obtained by the trawl off the east coast of South America at a depth of 600 fathoms. It is a dull grey-coloured soft-looking colony attached by a wide base to a mass of sand and fragments of Polyzoa and other foreign bodies (Pl. XXV. fig. 7). Small dark sand-grains are found scattered all over the upper surface. They add considerably to the darkness and opacity of the test. The bodies of the Ascidiozooids are of a dull yellow colour, and they are only seen indistinctly without dissection (Pl. XXV. fig. 7). No common cloacal apertures are visible.

The test, although it forms a large mass, is soft and is very readily torn, and even the presence of the imbedded sand fails to render it firm. In the outer layer where the test cells are very abundant and most of them fusiform and arranged with their long axes parallel, the matrix is slightly fibrillated. In other parts it is clear and apparently structureless.

The body of the Ascidiozooid is of very irregular form (Pl. XXV. fig. 9). In a specimen 7·5 mm. in length the thorax measured 2·5 mm., the abdomen 2 mm., and the post-abdomen 3 mm. The breadth varies greatly in the different regions. The thorax is nearly cylindrical, but the abdomen and post-abdomen are both irregularly swollen (Pl. XXV. fig. 9, *th.*, *ab.*, *p.ab.*).

The muscle fibres in the mantle are large (Pl. XXV. fig. 9, *th.*), but there are comparatively few in each bundle, and the bundles are not very closely placed. The atrial aperture is provided with a short pointed atrial languet. The branchial aperture is surrounded by six broad low lobes (Pl. XXV. fig. 9, *br.l.*). The sphincter is well developed. In the post-abdomen the muscle bands are feeble but very closely placed, they are all longitudinal in direction.

The transverse vessels of the branchial sac are wide, and have well-marked horizontal membranes (Pl. XXV. fig. 8, *h.m.*). The fine longitudinal vessels are wider than the stigmata. The endostyle is large and conspicuous, its course is undulating (Pl. XXV. fig. 9, *en.*).

The stomach is of large size and almost spherical, it is thick walled but smooth (Pl. XXV. fig. 9, *st.*). The intestine is long, it forms a narrow loop. The alimentary canal is so placed that the stomach lies not only on the ventral side of but anteriorly to a part of the rectum (Pl. XXV. fig. 9, *st.* and *i.*).

The post-abdomen is swollen in its upper part where the reproductive organs are placed, and is very narrow in its lower part (Pl. XXV. fig. 9, *p.ab.*). The edges are much corrugated. The ova are large and opaque. The vas deferens is wide and conspicuous in its whole course (Pl. XXV. fig. 9, *v.d.*). At the posterior extremity of the post-abdomen there are one or two short cæcal projections, resembling rudimentary vascular appendages (Pl. XXV. fig. 9, *v.ap.*).

Fully developed tailed larvæ were found in the peribranchial cavities of several of the Ascidiozooids. The body of the larva is narrow and elongated. There is a single pigmented sense-organ placed rather far back.

Polyclinum incertum, n. sp. (Pl. XXVI. fig. 10).

The Colony is a small irregularly rounded mass attached by one end and sometimes slightly pedunculated. The upper surface is broad and convex. The colour is a dark grey with a slight brownish tinge. The surface is uneven and not smooth.

The length is 1·3 cm., the breadth 1·2 cm., and the thickness 1 cm.

The Ascidiozooids are long and narrow. They may be 6 mm. antero-posteriorly and less than 1 mm. in greatest breadth. Fully half the length of the body is formed by the post-abdomen, but the separation into regions is not distinct superficially. The Ascidiozooids are of an opaque yellowish-brown colour, they are not arranged in systems.

The Test is soft and flexible, it is semi-transparent, and allows the bodies of the Ascidiozooids to show through distinctly. The matrix is clear, but is slightly fibrillated in some parts. The test cells are not very numerous. They are mostly rounded or fusiform in shape. There are no bladder cells.

The Mantle is moderately muscular, most of the muscle bands run longitudinally. The sphincter at the branchial aperture is well developed.

The Branchial Sac is small and its walls are opaque. The stigmata are very minute and inconspicuous.

The Endostyle is wide and has a very undulating course.

The Tentacles are rather long and narrow, and are of different lengths.

The Alimentary Canal is of moderate length, and the stomach is rather large.

The Post-Abdomen is large, and contains both male and female reproductive organs.

Locality.—Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8 F.

Three small colonies from Station 313 have been placed in this species. They are all different, but may, I think, be conveniently regarded as slight variations of one species. The colony from which the above description and measurements were taken is more

rounded and lighter in colour than the other two. It is attached to sand-grains, &c., by a narrow area at the posterior end. A second colony is much longer but narrower (Pl. XXVI. fig. 10). It is 2 cm. in length, 9 mm. in breadth, and 4 mm. in thickness. It has a long peduncle incrusted with dark coloured sand-grains. The third colony is much smaller, being 9 mm. in length, 8 mm. in breadth, and 5 mm. in thickness. It is darker in colour than the other two colonies. In all the specimens the upper surface where the anterior ends of the Ascidiozooids are placed is lighter in colour and softer than the rest of the colony. The surface is slightly roughened all over, and a few sand-grains are found adhering far above the base of attachment (Pl. XXVI. fig. 10).

The test is soft and is easily deformed, especially on the upper surface of the colony. Lower down the incrusting sand-grains make it stiffer. The dull brown bodies of the Ascidiozooids show through it distinctly on the sides of the colony. They are not so clearly visible on the upper surface.

There is no definite arrangement amongst the Ascidiozooids, but their anterior ends all point towards the upper surface, and their long bodies lie nearly vertically in the colony.

As usual the muscle bands of the mantle almost die away on the abdomen, but become stronger again on the post-abdomen. The branchial aperture is distinctly six-lobed. The branchial sac is very rudimentary, but the endostyle is broad and conspicuous.

The tentacles are exceptionally narrow, and some of them are of considerable length. There is no definite arrangement.

The œsophagus leaves the posterior end of the branchial sac and runs backwards to open into the large ovate stomach. The intestine is narrow; it arises from the posterior end of the stomach and turns almost at once dorsally and then anteriorly, forming a short but rather wide loop. The rectum is large, it runs forwards alongside the stomach, œsophagus, and branchial sac, to open into the peribranchial cavity.

The convoluted vas deferens is a conspicuous object in its entire length, both in the post-abdomen and also in its course alongside the rectum.

There are two or three small irregular projections at the posterior end of the post-abdomen, which look like rudimentary vascular appendages.

Polyclinum minutum, n. sp. (Pl. XXV. figs. 10–12).

The Colony is irregularly rounded in form, and is attached by a small area at one end. There is no lateral compression. The colour is dull yellowish-grey, and the surface is smooth.

The length is 1 cm., the breadth 1·3 cm., and the thickness 1·1 cm.

The Ascidiozooids are very small, about 3 mm. in length and 0·5 mm. in greatest breadth. They are not numerous, and are scattered quite irregularly over the colony.

The Test is very solid, and is nearly quite opaque. The matrix is crowded with test-cells.

The Mantle is thin but fairly muscular. The muscle bands are very delicate, and run mainly in a longitudinal direction. The branchial sphincter is fairly strong.

The Branchial Sac is of moderate size. The transverse vessels are all equally wide. The stigmata are large and well developed. They are wider than the fine longitudinal vessels.

The Dorsal Lamina is represented by languets.

The Alimentary Canal is large. The stomach is very long, and is smooth walled.

Locality.—Royal Sound, Kerguelen Island; depth, 20 to 60 fathoms.

The small colony placed in this species resembles *Amaroucium lævigatum* in its general appearance and in the solidity of the test, but differs from it in several points in the structure of the Ascidiozooids. It is a small nearly globular colony (Pl. XXV. fig. 10), which was obtained at Royal Sound, Kerguelen Island. It is of rather a dark colour, having a distinctly brown tinge, and is nearly opaque, the Ascidiozooids only showing through faintly even where they are close to the surface (Pl. XXV. fig. 10). A good deal of the irregularity of the specimen is due, I believe, to contraction on being put into alcohol; the shape was probably more nearly spherical when living. The Ascidiozooids are placed at various angles to the surface, and their bodies are found traversing the centre of the colony in all directions. The thorax of this species bears considerable resemblance to that of *Distaplia rosea* amongst the Distomidæ.

The test is very stiff and tough, not only on the external surface, but all through. It is very densely crowded with test cells, and these are rather larger than usual, and very granular. This causes the great opacity of the test. There are no bladder-cells and no vessels.

The mantle has a very delicate but fairly abundant musculature. On the post-abdomen the bundles are closely placed. The branchial aperture has six triangular lobes; the atrial aperture is prominent, and has a large rounded atrial languet (this was not visible in the Ascidiozooid figured, Pl. XXV. fig. 11).

The branchial sac is well developed. There are usually seven or eight rows of stigmata. The ciliated cells on the edges of the wide stigmata are large and conspicuous. The transverse vessels are wide and have horizontal membranes (Pl. XXV. fig. 12, *tr.* and *h.m.*). The tentacles are not numerous. The endostyle is conspicuous (Pl. XXV. fig. 11, *en.*).

The alimentary canal forms a long narrow loop (Pl. XXV. fig. 11, *ab.*). The œsophagus is a curved, funnel-shaped tube, which runs from the posterior end of the branchial sac to a point rather on the side of the stomach than at its anterior end. The stomach is very large, and is of an elongated, ovate form, the anterior end being wider

than the posterior, and being perfectly circular (Pl. XXV. fig. 11, *st.*). The stomach is thin walled and has no folds. In this respect it differs from the stomach of *Amaroucium lævigatum*, while in other respects the two alimentary canals are rather similar. The posterior end of the stomach tapers rapidly into the first portion of the intestine, which is a narrow tube running directly backwards. This is separated by a constriction from the second part of the intestine, which is wide and thick walled (Pl. XXV. fig. 11, *i.*) and turns abruptly towards the ventral side, and then anteriorly to open into the rectum. The last portion of the alimentary canal is a long thick-walled tube (Pl. XXV. fig. 11, *r.*) which runs forwards alongside the intestine, stomach, and œsophagus, crossing about the middle of its course so as to reach the dorsal side of the branchial sac. The rectum is much dilated at its commencement, and this part is separated from the intestine by a constriction or short narrow part of the tube.

The post-abdomen is large, and is not separated by any external constriction from the abdomen (Pl. XXV. fig. 11, *p.ab.*). The lower end of the post-abdomen is broad and rounded.

This species and *Amaroucium lævigatum* are certainly allied, notwithstanding their positions in distinct genera.

Aplidium, Savigny.

Aplidium, Savigny, Mémoires, 1816. In part.
Aplidium, Milne-Edwards, Observations, &c., 1842.
Aplidium, Forbes, British Mollusca, vol. i. p. 10, 1853. In part.
Aplidium, Giard, Recherches, &c., p. 635, 1872 (as a subgenus).
Aplidium, Delle Valle, Contribuzioni, &c., p. 34, 1877. In part.
Aplidium, von Drasche, Die Synascidien, p. 25, 1883 (as a subgenus).

Colony massive or lobed, not pedunculated.
Systems compound and irregular.
Ascidiozooids not much elongated; branchial aperture six-lobed, atrial lobed or having a rudimentary languet, and placed far back.
Test gelatinous or cartilaginous.
Branchial Sac fairly well developed.
Alimentary Canal of moderate size. Stomach-wall folded longitudinally.
Post-Abdomen usually short.

This genus, in the restricted sense in which it is now used, was established by Giard, and corresponds only to the first tribe of Savigny's *Aplidium*, a section characterised by the shortness of the post-abdomen. Giard in his classification of the Polyclinidæ used *Aplidium* in two senses:—(1) as a generic term opposed to *Polyclinum*, and including not only all the forms that Savigny included but the genus *Sidnyum* in addition; and

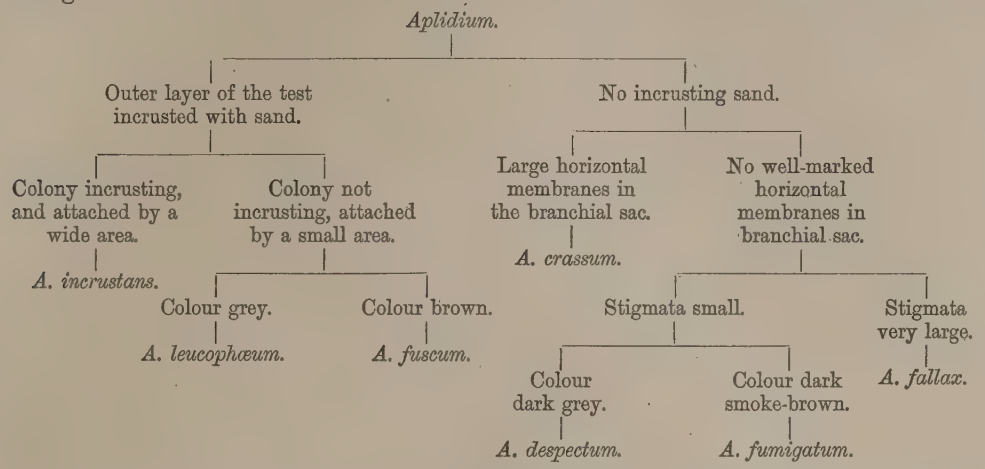
(2) as a subgenus or section of the wider *Aplidium*, and corresponding to the present genus. Giard considered this group of species as characterised by the six-lobed branchial aperture and the short post-abdomen. The first of these characters, however, is shared by nearly all of the Polyclinidæ, and characters derived from the post-abdomen are somewhat unreliable on account of the share which that part of the body takes in gemmation in the Polyclinidæ and its consequent changes in size.

Von Drasche apparently felt this objection, for while he retained Giard's subgenus, he added another character to its diagnosis, viz., that the atrial aperture is placed on the dorsal edge far behind the branchial, and has either no atrial languet or only a very small one. He figures a new species (*Aplidium asperum*, von Drasche) in which this feature is well seen, and seems to regard this amended definition of *Aplidium* as perfectly satisfactory. I am afraid, however, that it is little better than it was before. In the first place the type species of the genus *Amaroucium* (a genus which is most closely allied to *Aplidium*) has the atrial aperture placed far back on the dorsal edge; it is, however, provided with a large languet. And, secondly, the exact position of the atrial aperture varies considerably, not only in the different species of *Aplidium*, but even in the different Ascidiozooids of one colony, and in some cases it is found in an intermediate position which might either be described as dorsal or anterior.

In the Table on p. 152, von Drasche's characteristic has been made use of in distinguishing *Aplidium*, as I believe that it is somewhat more reliable than the length of the post-abdomen, but in any particular case where it failed to indicate the genus, then, on account of the six-lobed branchial aperture, the longitudinally folded stomach and the sessile post-abdomen, *Aplidium* would be thrown (see Table, p. 152) along with *Amaroucium* and *Sigillina*. The extremely long and attenuated post-abdomen of the latter genus, and its distinctly six-lobed atrial aperture, would sufficiently distinguish it from *Aplidium*, and consequently the only risk of confusion would be with *Amaroucium*. After a careful consideration of all the known species of both genera I find that there is no single reliable character which will separate the two groups in all their species. Consequently in such a case it would be necessary to make use of a combination of characters, of which the following are the most important:—

Aplidium.	*Amaroucium.*
Colony not pedunculated, Ascidiozooids not very long, atrial aperture placed dorsally and usually with no atrial languet, post-abdomen shorter than thorax and abdomen.	Colony often pedunculated or elongated vertically, Ascidiozooids long, atrial aperture anterior or slightly dorsal, provided with a large atrial languet, post-abdomen usually long.

The species of *Aplidium* in the Challenger collection may be distinguished by the following characters :—



These species are all new to science with the exception of *Aplidium fallax*, Johnston, a British species.

Aplidium incrustans, n. sp. (Pl. XXVII. figs. 3–8).

The Colony is quite irregular in shape. It is a large expanded incrusting mass attached by the greater part of the lower surface. The upper free surface is convex. The edges are thick and rounded. The colour is a dark dull grey with light grey spots formed by the bodies of the Ascidiozooids. The surface is even and smooth.

The length of the colony is 5·5 cm., the breadth is 3 cm., and the average thickness is about 0·5 cm.

The Ascidiozooids are large, measuring as much as 5 mm. in length. The greatest breadth is about 2 mm. They lie somewhat irregularly, but most of them are more or less at right angles to the upper surface. The part which is visible on the exterior of the colony is rather more than the anterior end, and forms a spot sometimes upwards of 2 mm. in its greatest extent. There is no long post-abdomen, and no vascular appendages are present.

The Test is soft, and tears readily. The external layer is rather firmer than the internal part, and is very smooth and glistening on the surface. Sand-grains are scattered sparsely all through the outer layer. In sections the test is seen to be crowded with cells of very considerable size and of various shapes. The commonest forms are triangular and stellate, with very long branched angles and processes. The nuclei are large and distinct. The matrix is clear and structureless.

The Mantle is fairly strong. The muscle bands are delicate but rather closely placed. They run chiefly in a transverse direction on the thorax.

The Branchial Sac is large and has many stigmata. The transverse vessels are wide and are all of the same size. The stigmata are very long and narrow. They are arranged with regularity.

The Endostyle is conspicuous. It has a very undulating course.

The Dorsal Lamina is composed of long triangular languets with pointed ends.

The Tentacles are large. There are about eight very long and the same number of smaller ones placed alternately.

The Alimentary and Reproductive Viscera are closely placed, and form a large opaque mass tapering towards the posterior end.

Locality.—Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2 F.

This species is represented by a large irregularly shaped mass and a few small lumps, all obtained from Station 320, off the east coast of South America, at a depth of 600 fathoms. The large mass, from which the measurements given above are taken, incrusts a fragment of a corallum[1] (Pl. XXVII. fig. 3), while the smaller colonies are attached to pieces of a Polyzoon. The smaller specimens are merely rounded lumps, and they agree in other particulars with the larger colony. The colour is a dark grey, which is produced by the test, while the bodies of the Ascidiozooids show through as patches of a lighter and slightly yellowish grey. No common cloacal apertures are visible, but the surface is not in perfect condition, being torn in places and somewhat distorted.

The Ascidiozooids are scattered apparently quite irregularly, and are fairly numerous (Pl. XXVII. fig. 3). They dip into the mass at various angles and are of different lengths. The anterior part of the body which shows through the transparent upper layer of test is from 1 mm. to 3 mm. in its greatest length.

The test is very soft, and as there is a good deal of it the colony as a whole is soft and easily deformed. It has evidently become considerably flattened and distorted in places from pressing against the sides of the bottle in which it was preserved. The outer layer of the test very readily tears off as a thin membrane; it is perfectly transparent. In this many sand-grains and fragments of sponge spicules and other foreign bodies are imbedded (see Pl. XXVII. fig. 4, where *o.s.* indicates the outer surface), and they are even found more rarely in the deeper layers of the test. The cells are particularly large, and give off very long and much-branched processes (Pl. XXVII. fig. 4, *t.c.*).

The colony is not attached by the entire lower surface. The rounded growing edges, which contain smaller and more regularly arranged Ascidiozooids, project freely and are not attached. The upper central part of the large colony has some of its Ascidio-

[1] Belonging to one of the Stylasteridæ.

zooids partly ejected from the test and in a decomposed condition, while large areas of test occur in which no Ascidiozooids are present. Hence it is probable that this is the oldest part of the colony, and that at the time when the specimen was collected many of the Ascidiozooids in this region had died and were being removed from the colony.

The branchial aperture is distinctly six-lobed, and the sphincter is well developed. Equidistant muscle bands are found running longitudinally in the mantle over the alimentary and reproductive viscera to the posterior end of the body.

The branchial sac is very long. It has in some cases at least fifteen rows of stigmata, with nearly twenty in each row. The stigmata are long and narrow (Pl. XXVII. fig. 5), and the stigmatic cells are convex on their free surfaces (Pl. XXVII. fig. 6) and richly ciliated. The transverse vessels (Pl. XXVII. fig. 5, *tr.*) are exceptionally wide for a Compound Ascidian.

The tentacles are large, and their bases, which are rather swollen, touch one another. The long tentacles are at least twice the size of the smaller intermediate ones (Pl. XXVII. fig. 8, *tn.*, *tn'.*). The dorsal languets are large and numerous. They are of the usual shape (Pl. XXVII. fig. 7, *l.*). The median dorsal line between them is occupied by a strong band of muscle fibres.

The alimentary canal forms a narrow loop, the elongated stomach and intestine lying close together. The wall of the stomach is very much folded, the longitudinal ridges projecting into the interior. The rectum is large, and is always filled with dark coloured fæcal matter.

The reproductive organs are of moderate size. They form a mass placed behind the intestinal loop, and continuing the abdomen posteriorly for a short distance, and then ending in a point. Thus no very distinct post-abdomen is formed. In most of the Ascidiozooids examined one or two large ova were found, more or less surrounded by a mass of small, ovate spermatic vesicles of an opaque dull yellow colour. The vas deferens is long and conspicuous. The spermatic vesicles and the vas deferens readily stain deep red with picro-carmine.

This species closely resembles *Polyclinum molle* in the external appearance (compare Pl. XXV. fig. 7, and Pl. XXVII. fig. 3), and also in the structure of the test, but they differ notably in the form of the Ascidiozooids and in the structure of the branchial sacs. In the condition of the post-abdomen the present species shows some resemblance to *Polyclinum fungosum*, but differs from it in the structure of the stomach.

Aplidium fuscum, n. sp. (Pl. XXVIII. figs. 8–10).

The Colony consists of a hemispherical mass, slightly compressed laterally, and attached by a small area in the middle of the lower surface. The upper end is broad

and convex, the lower is smaller and slightly concave. The surface is even, but somewhat roughened all over. The colour is brown.

The length is 1·6 cm., the breadth 2·2 cm., and the thickness 1·7 cm.

The Ascidiozooids are fairly large and numerous. Two or three common cloacal apertures are visible on the upper surface of the colony, but the Ascidiozooids are scattered evenly all over the surface, and do not seem to be arranged in systems. The Ascidiozooids are about 9 mm. in length and 1·5 mm. in greatest breadth. The body is quite opaque, and is not distinctly divided into regions. A slight constriction separates the thorax from the abdomen.

The Test is firm, and the outer layer is stiffened by imbedded sand-grains; it is of a brown colour and nearly opaque. The inner part is of a light grey colour, and is more transparent. The test cells are numerous and generally much branched. No bladder cells are present.

The Mantle is thick and very muscular. Both longitudinal and transverse muscle bands are present, and they are closely placed.

The Branchial Sac is of moderate size. There are more than twelve rows of stigmata, and the transverse vessels are wide and all of the same size. The stigmata are long and narrow and are arranged with regularity.

The Dorsal Lamina is represented by a series of languets.

The Tentacles are numerous and closely placed. They are of two sizes.

The Abdomen is relatively of large size, and is very opaque.

The Post-Abdomen is wide, but not very long.

Locality.—Royal Sound, Kerguelen Island, January 19, 1874; depth, 20 to 60 fathoms.

This species, of which a single colony was obtained in Royal Sound, Kerguelen Island, shows some resemblance to *Morchellium giardi* and *Sidnyum pallidum*, while it is very closely related to *Aplidium leucophæum* (see p. 205). It seems, however, to be a distinct form.

The colony is a rounded mass without a peduncle (Pl. XXVIII. fig. 8), and the surface is slightly but evenly incrusted all over with fine black sand-grains, which make it rough. The colour is a rich brown upon which the anterior ends of the Ascidiozooids stand out as small round yellowish spots, the whole being slightly obscured and darkened by the adhering sand-grains (Pl. XXVIII. fig. 8).

The common cloacal apertures are circular and about 1·5 mm. in diameter. The anterior ends of the Ascidiozooids are remarkably evenly distributed over the convex upper surface of the colony, and no traces of any division into systems, or of regular grouping around the common cloacal apertures, are visible.

The test is stiff and opaque, and the outer layer is particularly hard. The test cells

are of rather large size and of various shapes. In the outer layer they are very numerous and closely placed. The brown colour is probably due to their presence.

The musculature of the mantle is much more developed than is usual in Compound Ascidians. The transverse bands are closely placed, and over part of the thorax they form almost a continuous layer. The longitudinal bands are more distant, but they are strong. The whole arrangement recalls the musculature of some of the Cynthiidæ amongst the Ascidiæ Simplices. Possibly the stiffness of the outer layer of the test has necessitated this excessive development of the muscular system, in order that complete contraction of the Ascidiozooid might be effected.

The branchial aperture is wide, and is surrounded by six slight lobes (Pl. XXVIII. fig. 10, *br.*). There is almost no branchial siphon, and the sphincter muscle is not strong. The atrial aperture is provided with a large bifurcated atrial languet (Pl. XXVIII. fig. 10, *at.*).

The fine longitudinal vessels in the branchial sac are rather wider than the stigmata (Pl. XXVIII. fig. 9, *l.v.*). The transverse vessels have slight horizontal membranes. The branchial region of the body is usually about 3 mm. in antero-posterior extent. The endostyle is large and conspicuous (Pl. XXVIII. fig. 10, *en.*). Its course is undulating.

The alimentary canal is of considerable size and forms a narrow loop. The wall of the stomach is folded longitudinally. The rectum is a long wide thin-walled tube.

Aplidium leucophæum, n. sp. (Pl. XXVIII. figs. 5–7).

The Colony is an irregularly rounded mass, slightly compressed laterally, and attached by a small area at the posterior end. The upper surface is broad and irregularly convex. The lower end is relatively narrow, and the sides slope outwards and upwards. The surface is slightly rough all over. The colour is a dull grey, with pale, circular spots.

The length is 2 cm., the breadth is 2·3 cm., and the thickness is 1·7 cm.

The Ascidiozooids are fairly large and numerous. A single large common cloacal aperture is present in the middle of the upper surface of the colony, but the Ascidiozooids are placed evenly all over the surface, and do not seem to be arranged in systems. The Ascidiozooids are about 1 cm. in length and 1·5 mm. in greatest breadth. The thorax is separated from the abdomen by a marked constriction.

The Test is firm, and the outer layer is stiffened by imbedded sand-grains. It is of a dark grey colour and nearly opaque. The inner part is of a lighter grey colour, and is rather less opaque. The test cells are fairly large and rather numerous, especially in the outer layer. They are of all shapes, and are frequently much branched. No bladder cells are present.

The Mantle is thick and opaque. The musculature is very well developed on the thorax; both transverse and longitudinal bands are present.

The Branchial Sac is fairly large and very well developed. The transverse vessels are rather narrow and all of about the same size. The stigmata are large, numerous, and arranged with regularity.

The Dorsal Lamina is represented by a series of large triangular languets.

The Tentacles are large.

The Alimentary Canal is relatively of large size. It forms a long narrow loop.

The Post-Abdomen is wide but not very long.

Locality.—Kerguelen Island; depth, 10 to 60 fathoms.

This species is very closely allied to *Aplidium fuscum*, and may indeed turn out to be merely a variety of that species. They were both obtained at Kerguelen Island in comparatively shallow water. The external appearance is very much the same in the two colonies (compare figs. 5 and 8 on Pl. XXVIII.), except that the one is of a brown colour, while the other is dark grey. In both cases the anterior ends of the Ascidiozooids show on the upper surface of the colony as light-coloured areas, and in both minute black sand-grains are found adhering to the surface all over. In the present case the colony is rather more compressed, and the posterior end is narrower than in the former species.

The arrangement of the Ascidiozooids is precisely the same in the two cases, but they seem slightly larger in the present species, and the thorax is much more clearly separated from the abdomen. In some Ascidiozooids the two regions are merely united by a narrow neck, consisting of the œsophagus and rectum, which readily breaks. The thorax is about 3 mm. in length.

The test, although it differs in colour from that of *Aplidium fuscum*, is very similar in structure. The outer layer is rather lighter and less opaque, which is probably due to the test cells in that region being less granular.

The mantle is very muscular. The transverse bands are closely placed, but not quite so much so as in the case of *Aplidium fuscum*. The branchial siphon is very short, and the aperture is surrounded by six slightly marked lobes (Pl. XXVIII. fig. 6).

The branchial sac is a little different from that of *Aplidium fuscum*. The stigmata are rather larger, and the transverse vessels are narrower (Pl. XXVIII. fig. 7, *tr.*). Slightly developed horizontal membranes are present. There is no interruption on the dorsal edge of the sac, as the stigmata extend across from side to side continuously between the languets (Pl. XXVIII. fig. 7). The endostyle is long and rather narrow. Its course is undulating. The dorsal languets are slightly longer than the stigmata. They are flattened antero-posteriorly, and they taper to narrow points (Pl. XXVIII. fig. 7, *l.*).

The œsophagus is rather wide, and runs straight backwards (Pl. XXVIII. fig. 6). The stomach is moderately large, and is ovoid in form, with the narrower end anterior. Its walls are slightly ridged longitudinally. The first part of the intestine is narrow.

It runs posteriorly from the stomach for some distance, and then turns abruptly towards the dorsal edge and anteriorly to become the rectum (Pl. XXVIII. fig. 6). The most posteriorly placed part of the intestine is usually rather swollen. The rectum is a long, wide, thin-walled tube of very unequal calibre. It forms the dorsal part of the abdomen in its entire length.

There is no constriction or external line of demarcation between the abdomen and the post-abdomen (Pl. XXVIII. fig. 6), and these two regions are usually of the same length. The post-abdomen scarcely tapers at all, and its posterior end is broad and rounded. The musculature on the post-abdomen is rather feeble, and is entirely composed of longitudinal bands. In one specimen a clump of immature ova was found in the anterior half of the post-abdomen, but in the other Ascidiozooids examined the reproductive organs were in an undeveloped condition. The vas deferens, usually such a conspicuous organ in Compound Ascidians, was not visible.

Aplidium crassum, n. sp. (Pl. XXV. figs. 15, 16).

The Colony is an irregularly conical mass attached by the base, which is wide and spreading. The upper end is truncated and irregular in shape. The colour is an opaque whitish-grey, becoming slightly hyaline towards the point of attachment. The surface is very uneven but moderately smooth.

The length of the colony is 2 cm. and the greatest breadth (above the base) is 1·5 cm.

The Ascidiozooids are large, but they are rather deeply placed in the colony, and are only visible towards the posterior end. The body is about 7 mm. in length and 1·5 mm. in greatest breadth. The division into regions is not distinct.

The Test is firm and moderately tough. It is of a light grey colour, but is not transparent. The matrix contains a number of small test cells of various sizes and shapes, and also larger ovate or elliptical and very granular cells. Large bladder cells are present in the outer part of the test.

The Mantle is thick and opaque over the branchial region of the body, and the musculature is very powerful. Both transverse and longitudinal muscle bands are present, and they form a continuous muscular layer.

The Branchial Sac is short, but contains a good many rows of stigmata. The transverse vessels are wide and have well-marked horizontal membranes. The stigmata are short and rounded and rather numerous.

The Dorsal Lamina is represented by a series of rather short and broad languets with blunt points.

The Tentacles are large and all of much the same size. There are about twelve.

Locality.—Off Bahia, Brazil, in shallow water.

The single specimen of this species is an irregularly shaped colony rising from a thin extended base, which incrusts and unites a mass of shell fragments and other foreign bodies. The upper part of the colony has the form of an irregular truncated cone (Pl. XXV. fig. 15); there is no lateral flattening. The colony, although of a light colour, is very opaque, the Ascidiozooids being visible only near the base of attachment, where the test is more transparent, and they come nearer to the surface. They show as light yellowish-grey elongated marks upon the semi-transparent hyaline grey test (Pl. XXV. fig. 15). The surface of the colony is very uneven all over, and some of the foreign bodies are imbedded in the test more than half way up from the base.

The Ascidiozooids though large are not very long antero-posteriorly. They are thick and somewhat sausage-shaped (Pl. XXV. fig. 15). The anterior end is narrow and pointed, while the posterior is broad and rounded. The thorax occupies the anterior third or rather less, and is of a pale yellow colour, while the abdomen and post-abdomen have no clear line of demarcation, and are of a darker colour. The whole body is quite opaque. The broadest region is towards the posterior end of the abdomen.

The test is very thick and solid; it is quite opaque in the upper part of the colony, and is only transparent in thin layers in the lower part. The bladder cells are very numerous in some places, and reduce the matrix to a reticulum (Pl. XXV. fig. 16, *bl.*); in other parts they are entirely absent, and the matrix contains test cells of various kinds. Many of these are of regular ovate form and are filled with fine granules. Probably the opacity of the test is due to the presence of these cells. Here and there also groups of small granular cells occur placed close together. They have assumed polygonal forms from mutual pressure just as in the case of the similar cells in *Atopogaster aurantiaca*. Vessels are present in the test, they terminate in elongated ovate bulbs (Pl. XXV. fig. 16, *t.k.*).

The mantle is extraordinarily thick and muscular over the branchial part of the body. There are powerful bundles running both transversely and longitudinally, and forming a continuous muscular coating. This is quite unlike the usual condition in Compound Ascidians, and it recalls the condition of the mantle in typical Cynthiidæ amongst the Simple Ascidians.

The branchial sac is thick-walled and opaque. Its most notable features are the prominent horizontal membranes and the small rounded stigmata.

The dorsal languets are numerous and large. Their edges are richly ciliated, and at the base they become continuous with the horizontal membranes of the transverse vessels. The large tentacles are closely placed, and seem almost to fill up the branchial siphon.

The alimentary canal is wide but not very long. It is of an opaque yellow colour.

The reproductive organs lie in the intestinal loop, and extend beyond it for a short distance forming a small post-abdomen. Both ova and spermatic vesicles are present in

the Ascidiozooid at the same time. The mature ova are large and of a bright yellow colour. The spermatic vesicles are small and ovate or pyriform; they are very numerous. The vas deferens is long and conspicuous, and is coiled spirally throughout its course. No larvæ were found in the Ascidiozooids examined.

Aplidium fallax, Johnston (Pl. XXVIII. figs. 1–4).

Aplidium fallax, Johnston, Mag. Nat. Hist., ser. 1, vol. vii. p. 15, figs. 4–18.
Aplidium fallax, Johnston, Forbes and Hanley, British Mollusca, vol. i. p. 11, Pl. A. fig. 1, 1853.

Two specimens obtained during the cruise of H.M.S. "Porcupine" in the summer of 1869, in Loch Foyle on the north coast of Ireland, from a depth of 10 fathoms, appear to be referable to *Aplidium fallax*, a species described by Johnston in 1834, and figured by Forbes in 1853. Johnston's specimen was from Berwick Bay, deep water, and Forbes' from the Isle of Man.

The two colonies in the "Porcupine" collection are fixed to the same fragment of a Hydroid Zoophyte and are both of much the same size, about 1 cm. in length, 1·5 cm. in breadth, and 1 cm. in thickness (Pl. XXVIII. fig. 1). The general shape is irregularly ovate, the area of attachment being the middle of the lower surface, which is rather small, while the upper surface is larger and gently convex. The whole surface is rather uneven. The colour is a dull grey with pale opaque yellow spots. No common cloacal apertures are visible on either of the colonies.

The Ascidiozooids are fairly large and rather numerous (Pl. XXVIII. fig. 1). They are placed with their long axes perpendicular to the upper surface of the colony, but they are not arranged in regular systems. The body is usually 3 mm. in length and 1 mm. in breadth, and is not distinctly divided into regions externally (Pl. XXVIII. fig. 2). The thorax is longer than the abdomen, and the post-abdomen is usually rather shorter than the abdomen.

The test is moderately firm, but on account of the large number of Ascidiozooids in the colony it never becomes very thick. It is of a dull grey colour and is semi-transparent. It contains abundance of test cells, some of which are of rather large size; their protoplasm is usually granular.

The mantle is not thick, and is transparent. The muscle bands are few in number and rather weak. They mostly run in a longitudinal direction. The branchial siphon is well developed, and its aperture is six-lobed (Pl. XXVIII. fig. 2, *br.*). The atrial aperture is provided with a well-marked atrial languet.

The branchial sac is large and well developed. The transverse vessels are narrow and all of the same size; they are supplied with muscle fibres. The stigmata are rather long (Pl. XXVIII. fig. 3, *sg.*). They are arranged with great regularity, and are of about the same size as the fine longitudinal vessels between them. Near the ventral

and sometimes also the dorsal ends of each row the stigmata rapidly become smaller, leaving the transverse vessels with wide triangular ends (Pl. XXVIII. fig. 3, *sg'.*), as in *Distaplia* (compare Pl. XVIII. fig. 3). The languets along the dorsal line of the sac are large triangular flaps flattened antero-posteriorly (Pl. XXVIII. fig. 4, *l.*). In some cases the stigmata extend in an uninterrupted series across the dorsal line. The endostyle is conspicuous and has an undulating course.

The alimentary canal is rather large, but the loop it forms is remarkably short (Pl. XXVIII. fig. 2, *i.*). The œsophagus leaves the dorsal edge of the posterior end of the branchial sac and runs for a short distance backwards. The stomach lies on the dorsal edge of the abdomen. It is short and wide, and its wall is thrown into a series of longitudinal folds (Pl. XXVIII. fig. 2, *st.*). The intestine, which is wide and thin-walled throughout, leaves the posterior end of the stomach and turns at once ventrally and then anteriorly. On reaching the level of the front of the stomach it crosses to the dorsal edge of the abdomen, passing over the left side of the œsophagus, and then turns anteriorly to become the rather short wide rectum which runs along the dorsal edge of the thorax (Pl. XXVIII. fig. 2, *r.*). The intestinal loop is wide and forms the ventral part of the abdomen. The intestine and rectum are filled with dark coloured fæcal matter in their entire length.

The post-abdomen is short and wide (Pl. XXVIII. fig. 2, *p. ab.*). It contains both male and female reproductive organs, the ova being placed at the anterior end, while the spermatic vesicles occupy the remainder of the region. The mature ova are large and of a bright yellow colour. The vas deferens is usually conspicuous. Some of the Ascidiozooids examined contained several large tailed larvæ in the peribranchial cavity. The body of the larva is of nearly globular form, and has two pigmented sense-organs.

Aplidium despectum, n. sp. (Pl. XXVIII. figs. 11–13).

The Colony is an irregular mass consisting of two rounded pieces connected by a narrow neck. It was attached by a small area at one end. The surface is irregular but fairly smooth. The colour is a pale brownish-grey.

The length is about 2 cm., the greatest breadth 1·3 cm., and the thickness 0·5 cm.

The Ascidiozooids are small, and appear to be placed quite irregularly. No systems and no common cloacal apertures are visible.

The Test is firm and cartilaginous. It is of a dull grey colour and nearly opaque. The clear matrix is crowded with large test cells, mostly of rounded form and with granular contents. Some of them are slightly pigmented. No bladder cells are present.

The Mantle is moderately thick, but not very muscular. It is rather opaque.

The Branchial Sac is small and opaque. The stigmata are minute ovate slits placed rather far apart.

The Post-Abdomen is short and opaque.

Locality.—Station 48, May 8, 1873; lat. 43° 4′ N., long. 64° 5′ W.; depth, 51 fathoms; bottom, rock.

There is only a single specimen (obtained on the Le Have Bank, off Nova Scotia, from a depth of 51 fathoms) of this species in the collection, and I am inclined to think that it is probably a stunted and abnormally shaped colony (Pl. XXVIII. fig. 11). From the small base of attachment it expands upwards to form a rudely pear-shaped mass, slightly flattened laterally, and connected with another mass of somewhat similar shape and about the same size by a narrow bar about 4 mm. in length and 2 mm. in thickness. Possibly the colony was placed in an irregular crevice between stones. The colour is a dirty fawn, upon which the pale brown bodies of the Ascidiozooids are scarcely visible (Pl. XXVIII. fig. 11).

The bodies of the Ascidiozooids are short, and are not distinctly divided into regions. They are usually about 1·5 mm. in length, and are quite opaque. Their anterior ends occupy slight eminences on the surface of the colony, which give it in places a somewhat roughened appearance.

The test is rather remarkable in its minute structure. It is densely crowded with test cells, most of which are of very large size (Pl. XXVIII. fig. 12, *t.c.*). All the usual shapes are present, but circular and ovate forms are the most abundant, and many of them are very regular in their outlines. The opacity of the test is in all probability due to the presence of these cells. In the outer layers of the test a good many small sand-grains and minute fragments of shells, &c., may be found imbedded.

The chief muscle bands in the mantle run longitudinally. There are only a very few muscle fibres in each band. The sphincter at the branchial aperture is rather feeble.

The branchial sac occupies nearly half the length of the body, but it is narrow and in a lowly developed condition, the stigmata being few in number and of small size (Pl. XXVIII. fig. 13). The stigmatic cells are rather conspicuous.

The alimentary canal is not large, and it forms a short loop. The wall of the stomach is folded. The post-abdomen does not extend far beyond the intestinal loop, and is not separated from it by any constriction. The vas deferens is a wide tube, which is conspicuous running along the dorsal edge of the post-abdomen and abdomen.

In one of the Ascidiozooids examined, a single very large tailed larva (about 0·75 mm. in diameter) of nearly globular form was found in the dorsal part of the peribranchial cavity.

Aplidium fumigatum, n. sp. (Pl. XXVI. figs. 8, 9).

The Colony is of ovate or elongated form, and is attached by the narrower end. Several masses may be united by their lower ends or by a short thick stolon. The upper end is broad and rounded, sometimes laterally compressed. The colour is a dull greyish-

brown marked with dark yellow patches which indicate the Ascidiozooids. The surface is uneven but smooth.

The length is 2 cm., the greatest breadth is 1·3 cm., and the thickness is about 7 mm.

The Ascidiozooids are large. They are elongated opaque dull yellow bodies, about 1·5 cm. in extreme length and 1·5 mm. in greatest breadth. They are not divided externally into regions, and are so opaque that nothing of their anatomy can be made out from the exterior.

The Test is cartilaginous and firm, but not tough. It is rather opaque and of a dull greyish-brown colour. The homogeneous matrix is crowded with numerous small cells mostly of rounded forms. No large bladder cells are present.

The Mantle is moderately thick and very opaque. The muscle bands run chiefly in a longitudinal direction and are numerous and of considerable size.

The Branchial Sac is very thick and opaque. The transverse vessels and the fine longitudinal vessels are very wide, the result being that the stigmata are greatly reduced; they are in the form of small rounded or ovate apertures placed far apart.

Localities.—(*a*) Royal Sound, Kerguelen Island, 28 fathoms (two colonies). (*b*) Kerguelen Island, 10 to 100 fathoms (one colony). (*c*) Kerguelen Island, 10 to 60 fathoms (one large colony). (*d*) Zebu, Philippine Islands, the reefs (one colony).

The colour of this species is a characteristic, which serves to distinguish it at a glance from any other Compound Ascidian I have examined. It is a dark greyish-brown or smoke colour, with rounded or elongated dull yellow patches here and there. The specimen from the reefs at Zebu, Philippine Islands, is rather darker, and has the yellow patches less apparent than in the specimens from Kerguelen Island. This difference is due merely to a slightly greater development of pigment in the test, which is thus rendered more opaque. The specimen labelled "Kerguelen, 10 to 100 fathoms," is decidedly greyer than the others, and shows less of a brown tint. The large colony from Kerguelen, 10 to 60 fathoms, has the upper part of a dark smoky-brown colour, while the basal part becomes gradually lighter till it is of a dull grey.

In shape the colony is an ovate or elongated mass attached by the narrower end either directly or by means of a short thick stolon. In the larger colony from Royal Sound, Kerguelen,[1] there are three more or less ovate masses connected by prolongations of their lower ends forming a stolon (Pl. XXVI. fig. 8). This stolon is not so brown as the upper part of the colony. The specimen from Kerguelen, 10 to 100 fathoms, consists of three masses joined together by their lower ends without the intervention of any distinct stolon. The remaining specimen from Royal Sound, Kerguelen, and the one from Zebu, are each formed of a single mass attached by the lower end. The Zebu specimen has a rather more elongated form than any of the others. The large colony

[1] There is a small colony of *Amaroucium variabile* attached to one of the masses of this specimen.

from Kerguelen, 10 to 60 fathoms, consists of four ovate masses united irregularly by thick peduncles. This colony is much larger than any of the others. The unevenness of the surface in some of the specimens is, I believe, the result of unequal contraction at death.

The upper end of the colony is always rounded, and the point of greatest breadth is usually not far from this end (Pl. XXVI. fig. 8). The dimensions given above are taken from one of the medium sized specimens. The largest colony in the collection measures about 9 cm. in length and 4 cm. in greatest breadth. The smallest specimen is 11 mm. in length and 6 mm. in breadth.

The Ascidiozooids are large and not numerous (Pl. XXVI. fig. 8); they are not arranged with any regularity. They lie more or less vertically in the test, and their anterior ends nearly all open upon the convex upper end of the colony. In the specimens from Royal Sound, Kerguelen, and the large colony from Kerguelen, 10 to 60 fathoms, the Ascidiozooids are particularly conspicuous, and form large opaque yellow marks upon the exterior of the colony.

The test is firm to the touch but tears readily. The outer layer is rather harder and tougher than the interior. It is rather opaque, and only allows the Ascidiozooids to show through when they are close to the surface.

There are no bladder cells and apparently no vessels present (Pl. XXVI. fig. 9). The small test cells are of various sizes and shapes, and many of them are darkly pigmented. These pigment cells are rather more numerous in the outer layer of the test and immediately around the bodies of the Ascidiozooids than elsewhere. In some places they lie closely crowded together so as to form groups in which some of the cells have become more or less polygonal from mutual pressure (Pl. XXVI. fig. 9, *t.c'.*).

The mantle is strongly muscular, and both longitudinal and transverse bands are present, although the former are the largest and most numerous. In some places the muscle bands are very wide and are found to branch and anastomose freely. The ectoderm can be stripped off as a distinct membrane from the surface of the mantle. It is formed of rather large polygonal cells.

The branchial sac is in a very rudimentary condition. As the stigmata are few in number and are reduced to small rounded apertures rather irregularly placed, it is impossible to distinguish the usual systems of vessels.

The alimentary canal is short and wide, and of an opaque yellow colour. The reproductive organs are placed close behind the intestinal loop, consequently the post-abdomen is very short. Young and mature ova of various sizes were found in the Ascidiozooids.

The remaining organs of the body were not worked out in detail on account of the unfavourable condition of the specimens for examination. The tissues are all exceedingly opaque, and the Ascidiozooids, especially in their anterior parts, are much contracted.

Amaroucium, Milne-Edwards.

Aplidium, Savigny, Mémoires, 1816. In part.
Amaroucium, Milne-Edwards, Observations, &c. In part.
Amouroucium, Forbes, British Mollusca, vol. i. p. 15, 1853. In part.
Amaroucium, Giard, Recherches, &c., p. 636, 1872 (as a subgenus).
Amaroucium, Della Valle, Contribuzioni, &c., 1877 (as a subgenus).
Amaroucium, von Drasche, Die Synascidien, 1883 (as a subgenus).

Colony massive, sometimes lobed or pedunculated.
Systems compound and irregular.
Ascidiozooids elongated; branchial aperture six-lobed; atrial usually provided with a long languet.
Test gelatinous or cartilaginous.
Branchial Sac moderately developed.
Alimentary Canal of moderate size; stomach-wall folded longitudinally.
Post-Abdomen large.

Savigny, on account of all his material having been preserved in alcohol, erroneously described his genus *Aplidium* as having no common cloacal cavities, and when Milne-Edwards some years later worked at the Compound Ascidians of the Chausey Archipelago and some other parts of the coast of France in a fresh and living condition he found that none of the species he examined belonged to the genus *Aplidium*. All of those which in other respects agreed with that genus differed from Savigny's definition in having common cloacal apertures. Consequently he established for those forms the genus *Amaroucium*, agreeing with *Aplidium* in most respects, but having common cloacal cavities in the systems.

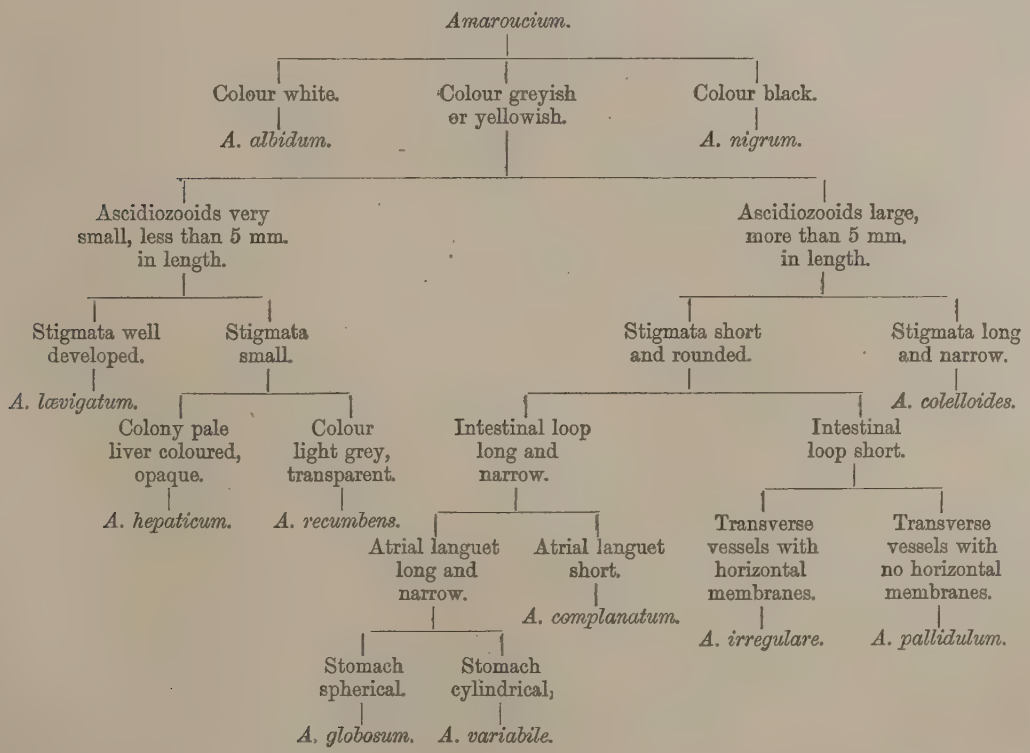
As no species of *Aplidium* in Savigny's sense have since been found in a living condition, it is very probable that, as Giard has suggested, the apparent absence of common cloacal cavities in spirit-specimens is a result of contraction after death, and that Savigny's species of *Aplidium* really had the cavities, and that therefore Milne-Edwards' *Amaroucium* was unnecessary and is merely a synonym of *Aplidium*. Giard, however, in subdividing the Polyclinidæ into genera and subgenera, has retained the name *Amaroucium* for one of the latter. Its characteristics are the long Ascidiozooids, the six-lobed branchial aperture, the anteriorly placed atrial aperture provided with a long atrial languet, the longitudinally folded stomach-wall, and the sessile and greatly elongated post-abdomen; for a discussion of its exact relations to *Aplidium* in the restricted sense, see under that genus, page 200.

Amaroucium is distinguished from *Sigillina*, Savigny, by its unlobed atrial aperture and by the possession of a large atrial languet; while from *Polyclinoides*, von Drasche, it differs mainly in not having any constriction between the abdomen and the post-

abdomen. These are the only genera which are very closely allied to it: the other Polyclinidæ may be all readily distinguished from *Amaroucium* by the characters of the branchial aperture, the structure of the branchial sac, and the condition of the stomach and the test (consult table, p. 152).

This genus is one of the largest in the Polyclinidæ, and contains some of the commonest and most widely distributed forms. In addition to Savigny's and Milne-Edwards' species, others have been described by Olivi, Renier, Della Valle, von Drasche, and others, and now at least eleven new species and several varieties have been added by the Challenger investigations. These new species may be distinguished by means of the table which follows.

It would have been much better in this and all the similar tables if I could have included all the known species of the genus. I have done so wherever it was possible, but in many cases the descriptions of the older species are so short and so imperfect that from the absence of any details of their structure it is quite impossible to include them in the tabular schemes or assign them to their proper positions in the genus.



Amaroucium variabile, n. sp. (Pl. XXIX. figs. 7–12).

The Colony consists of one or more masses of an irregularly ovate or pyriform shape attached by short peduncles. The upper end is broad and generally more or less convex. There may be slight lateral compression. The surface is generally rather uneven and not smooth. The colour is usually yellowish-grey, but may be darker.

The length is 2·5 cm., of which 5 mm. is formed by the peduncle; the greatest breadth is 1·7 cm., and the thickness is about 1 cm.

The Ascidiozooids are numerous and of large size. They are distinctly visible on the outside of the colony. They are usually about 6 mm. in antero-posterior length, and are placed with considerable regularity at right angles to the upper surface of the colony. The division of the body into regions is not distinct.

The Test is firm and cartilaginous. It is of a yellowish-grey colour and is semi-transparent. The matrix is clear and structureless, but it is crowded with minute test cells of various shapes. There are no bladder cells, and no vessels are present.

The Mantle is fairly strong. The musculature consists mainly of a series of longitudinally running bands of fibres placed at equal distances.

The Branchial Sac is well developed. The transverse vessels are fairly wide and have muscle fibres. The stigmata are numerous, but small and inconspicuous.

The Alimentary Canal forms a long narrow loop. The stomach is rather cylindrical in shape, and its wall is longitudinally folded.

The Post-Abdomen is usually of large size.

Localities.—(*a*) Kerguelen Island, 10 to 60 fathoms; (*b*) Kerguelen Island, 10 to 100 fathoms; (*c*) Kerguelen Island, 28 fathoms; (*d*) Royal Sound, Kerguelen, January 19, 1874, 20 to 60 fathoms.

I unite under this species a large number of specimens, collected in the neighbourhood of Kerguelen Island, which present great variations in form, size, colour, and some other particulars. They are, however, all closely related to one another, and although it might be possible to break them up into two or three species, I believe that the differences between the extreme forms are sufficiently bridged over by intermediate conditions to warrant one in regarding them as composing a single species only. They form an extremely interesting series on account of the way in which they illustrate individual variation.

The shape may vary from almost spherical through ovate, ellipsoidal, discoid, and pyriform, to fusiform or wedge-shaped or even quite irregularly elongated forms. The woodcuts (fig. 9, *a* to *l*) show a few of the most striking forms assumed by the species. There are upwards of thirty colonies altogether in the collection, and no two of them have the same shape. In most cases the colony consists of one mass only, and is attached by a longer or shorter peduncle (fig. 9, *b*, *c*, *g*); sometimes the peduncle is prolonged

to form a creeping stolon (fig. 9, *a* and *k*), and in one or two cases two masses are attached by peduncles to the same stolon (fig. 9, *l*). One colony from Kerguelen, 10 to 100 fathoms, consisting of two masses, has no peduncle. Two other colonies from the same locality are attached to the long peduncles of *Colella pedunculata*.

The colour varies from light grey through various shades of yellowish-grey to brown.[1] A warm yellow-grey, spotted with opaque light yellow is the most usual colour. The upper surface is generally uneven and rough, but the peduncle is smooth. The smallest colony measures 8 mm. in length and 4 mm. in breadth, the largest (one of the brown variety) is 8 cm. in length and 4·5 cm. in breadth.

The Ascidiozooids are conspicuous. Their anterior ends are all placed upon the upper, usually broad and rounded, end of the colony (Pl. XXIX. fig. 7), and they form circular areas from 0·5 to 1 mm. in diameter, raised slightly above the general surface.

Fig. 9.—*a* to *l*. Eleven colonies of *Amaroucium variabile*, to illustrate the extent of individual variation in this species.

There is usually a common cloacal aperture on the upper end of the colony, and the Ascidiozooids are then arranged in several irregular circles around it. In the larger colonies there are two or three such apertures on the upper surface, but in some of the smaller ones there appear to be no common cloacal cavities present.

The long narrow bodies of the Ascidiozooids are generally visible on the sides of the colony extending downwards towards the peduncle (see fig. 9). The proportions of the body of the Ascidiozooid vary considerably in different colonies, and the difference seems to be due to the size of the post-abdomen. In some cases, although the anterior region of the body is large, the post-abdomen is comparatively short, while in other colonies it is of very great length (Pl. XXIX. fig. 9, *p.abd.*). The Ascidiozooids vary in antero-posterior extent from 3 mm. to 10 mm., and in greatest breadth from 0·5 mm. to 1 mm. The thorax is usually about 1 mm. and the abdomen 1·5 mm. in length.

[1] The darker specimens, of which there are a considerable number, are mostly larger than the others, and might be regarded as forming a distinct variety. They are very variable in shape. Figures 7 and 8 on Plate XXIX. were drawn from one of the brown specimens.

The Ascidiozooids are of a pale yellow colour, and are usually quite opaque. The yellowish tint in the colouring of the colony is due to their presence. The brownish tint in some of the colonies is, on the other hand, caused by the darker colour of the test in these cases, the bodies of the Ascidiozooids showing through as lighter coloured patches on the dark brownish-grey ground.

The small cells in the test vary considerably both in size and shape (Pl. XXIX. fig. 8, *t.c.*). In some places they are aggregated to form small clumps which look like the terminal knobs of vessels; they are, however, merely groups of closely-placed test cells. Many of the cells have granular contents, but no regular pigment corpuscles were noticed except in the case of the brown coloured specimens, where they are abundant. These pigment cells are circular in form and of small size.

The musculature of the mantle is rather regular. The lobes at the branchial aperture are six in number, in some cases they are very well marked (Pl. XXIX. figs. 9, 10, *br.*). The atrial aperture is provided with a very long narrow atrial languet (Pl. XXIX. figs. 9, 10, *at.l.*), which is directed anteriorly and towards the branchial aperture.

The branchial sac in all the Ascidiozooids was considerably corrugated, but whether this condition is natural, or the result of contraction on being put into alcohol, I am unable to say. There are a good many rows of rather narrow stigmata. The ciliated cells are distinct and have pointed free ends. The endostyle is inconspicuous; its course is undulating.

The alimentary canal is long and narrow (Pl. XXIX. fig. 9). The œsophagus runs straight backwards to open into the rather cylindrical stomach, which lies with its long axis directed antero-posteriorly (Pl. XXIX. fig. 9, *st.*). There are about fourteen well-marked longitudinal folds, which are seen in transverse sections of the abdomen to extend about half-way into the cavity (Pl. XXIX. fig. 12). The intestine extends for a considerable distance behind the stomach, and then turns abruptly to the dorsal edge and then anteriorly, forming a narrow loop. The tube usually becomes slightly enlarged in its most posteriorly placed part before turning forwards (see Pl. XXIX. fig. 9, *i.*). The rectum is long and rather narrow, and in its upper part it is very narrow. It lies alongside the intestine, stomach, and œsophagus, and then courses along the dorsal edge of the branchial sac. It forms the dorsal edge of the thorax and abdomen in their entire length (Pl. XXIX. fig. 9, *r.*).

The post-abdomen is very large, it is usually about twice as long as the thorax and abdomen together, and is nearly as wide as the thorax (Pl. XXIX. fig. 9, *p.abd.*). It is very opaque except along the middle, where there is a narrow clear line formed by the lumen of the double septum. This cavity is clearly visible in transverse sections of the post-abdomen (see Pl. XXIX. fig. 11). There is generally a slight constriction separating the abdomen from the post-abdomen.

In external appearance this species shows some resemblance to *Aplidium fuegiense*,

Cunningham, which was found in the Strait of Magellan during the cruise of H.M.S. "Nassau." That species is, however, described[1] as being of a pale bluish-grey colour, and may possibly be more nearly allied to *Amaroucium complanatum* (see p. 221).

Amaroucium variabile, var. *tenerum*, nov. (Pl. XXIX. fig. 6).

Two of the smaller colonies from Kerguelen Island, 28 fathoms, and three of those from Kerguelen Island, 10 to 60 fathoms, differ considerably from all the other specimens. They are of somewhat elongated form and have no peduncle (see fig. 9, *e.*, p. 217). One of the colonies from Kerguelen, 10 to 60 fathoms, consists of three masses (Pl. XXIX. fig. 6). The colour is a pale grey with no yellow tinge, and the surface is smooth.

The Ascidiozooids are rather narrower and more transparent than in the other colonies (Pl. XXIX. fig. 6), and the stomach has the longitudinal folds very slightly marked. In other respects these specimens agree with the description of the species given above. They may be regarded as forming a well-marked variety.

Amaroucium globosum, n. sp. (Pl. XXIX. figs. 1–5).

The Colony consists of a globular mass supported by a very short stout peduncle. There is a distinct constriction at the top of the peduncle, and the lower end is rounded, the area of attachment being very small. The surface is even, but not quite smooth. The colour is a pale yellowish-grey, becoming slightly darker on the peduncle.

The extreme length is 4 cm., of which 1·7 cm. is the peduncle; the greatest breadth is 2·7 cm. and the greatest thickness is 1·8 cm. The thickness of the peduncle is 1·5 cm.

The Ascidiozooids are of moderate size, and are not very numerous. They are arranged in systems of somewhat irregular shape formed by branched lines radiating from the common cloacal apertures, several of which are visible upon the upper surface of the colony. The Ascidiozooids are about 7 mm. in length and 1 mm. in breadth. The body is clearly divided into three regions, of which the post-abdomen is the longest and the abdomen the shortest.

The Test is soft and gelatinous in the upper part of the colony, but much stiffer in the peduncle. The outer layer all over the surface is firmer than the inner part, and may be separated as a distinct membrane. The test is of a light grey colour, and is transparent. The test cells are numerous but small and not pigmented. No bladder cells are present.

The Mantle is thick and opaque. The musculature is not very strong, and the chief muscle bands run longitudinally. The branchial sphincter is well developed.

[1] *Trans. Linn. Soc. Lond.*, vol. xxvii. p. 465, 1871; and Notes on Natural History of Strait of Magellan, p. 66, Edinburgh, 1871.

The Branchial Sac is large, and has numerous rows of stigmata placed with great regularity. The stigmata are rather short and rounded.

The Dorsal Lamina is represented by a series of languets.

The Alimentary Canal is of moderate length. The stomach is short and wide, and has a few longitudinal folds.

The Post-Abdomen is long and tapers towards the free end. It contains both male and female reproductive organs at the same time.

Locality.—Kerguelen Island; depth, 10 to 60 fathoms.

Two specimens in the collection made at Kerguelen Island have been referred to this species, but they differ somewhat in their characters. The description given above is taken from the larger colony (Pl. XXIX. fig. 1). The other differs from it in having almost no peduncle, the globular mass in which the Ascidiozooids are placed being attached by its lower end to a projection composed partly of a prolongation of the test, but mainly of incrusting Sponges and other foreign objects (Pl. XXIX. fig. 2). The test of this colony is exceedingly soft and flexible, and the Ascidiozoods are more numerous than in the larger specimen. The length (exclusive of the prolongation at the base) is 1·6 cm., the breadth is 1·8 cm., and the thickness is 1·3 cm.

In both cases the Ascidiozooids are situated near the base of the globular part of the colony, having apparently been retracted from the upper surface (Pl. XXIX. figs. 1, 2). In both specimens the Ascidiozooids are clearly visible as pale yellow opaque spots upon the clear yellowish-grey test. In the smaller colony (Pl. XXIX. fig. 2) they are rather shorter and broader than the dimensions given in the above description. The arrangement of the Ascidiozooids is the same in both specimens. They are placed vertically in the test, but it is rather difficult to make out the exact shape of the systems. These are not very large, and they are in an intermediate condition between the form found in the genus *Botryllus* and that characteristic of *Botrylloides*. The common cloacal apertures are of small size and are circular in outline.

The test cells are very varied in form, and nearly always have long delicate processes; stellate and branched forms are very common. In addition to the longitudinal muscle bands, the mantle is provided with numerous very delicate fibres which run transversely and obliquely over the thoracic region of the body. The longitudinal bands are numerous and very regularly placed on the post-abdomen. The atrial aperture is provided with a narrow tapering atrial languet which varies considerably in size in different Ascidiozooids. It is often much longer than is shown in the figure (Pl. XXIX. fig. 4, *at.l.*), and in one case was found to be bifurcated, each half tapering to a pointed apex.

The branchial sac is generally about 1·5 mm. to 2 mm. in length and 1 mm. in breadth. The numerous transverse vessels are all of the same size, and are prolonged

inwards to form slight horizontal membranes projecting between the rows of stigmata (Pl. XXIX. fig. 3, *h.m.*).

The endostyle is large and conspicuous (Pl. XXIX. fig. 4, *en.*). Its course is very undulating. The dorsal languets are large and closely placed.

The œsophagus is a long narrow curved tube with the convexity dorsal (Pl. XXIX. fig. 4, *œ.*). The stomach is not large; its shape is almost spherical. The wall is thick, and is folded longitudinally; the folds are especially prominent at the anterior end (Pl. XXIX. fig. 4, *st.*). The intestine is narrow in its first part, which runs posteriorly from the stomach. It usually becomes dilated (see Pl. XXIX. fig. 4, *i.*) just at its most posterior part before turning ventrally and anteriorly to pass into the rectum; the intestinal loop is narrow. The rectum is a long wide thin-walled tube running up the ventral edge of the abdomen and thorax (Pl. XXIX. fig. 4, *r.*). It is usually filled with dark-coloured fæcal matter, and is just visible to the unaided eye in making a dissection of the colony.

The post-abdomen (Pl. XXIX. fig. 4, *p.abd.*) has its edges very irregular, and usually sacculated in appearance. The spermatic vesicles are spherical in shape, and have each a fine duct which runs to the lower end of the vas deferens (Pl. XXIX. figs. 4 and 5, *t.v.* and *v.d.*). They stain a deep red colour with picrocarmine. The vas deferens is large and conspicuous, and of great length. The ducts from the vesicles are all attached along one side of it (Pl. XXIX. fig. 5). The ova are of a bright yellow colour. They are placed in the anterior part of the post-abdomen.

The lower end of the post-abdomen is usually somewhat swollen (Pl. XXIX. fig. 4, *v.ap'*), and it gives off two or three very short cæcal processes which are evidently rudimentary vascular appendages.

Amaroucium complanatum, n. sp. (Pl. XXX. figs. 16–17).

The Colony has the form of an ovate or pyriform mass attached by one end and much compressed laterally. The upper end is broad and rounded, but thin. The surface is rather uneven. The colour is a light grey.

The length is 3 cm., the breadth is 2 cm., and the thickness 5 mm.

The Ascidiozooids are fairly large and numerous. They are greatly elongated antero-posteriorly, and are placed vertically in the colony. The body varies from 5 mm. to 1 cm. in length, and is less than 1 mm. in breadth. It is not divided into regions externally.

The Test is firm and rather tough. It is of a light grey colour and is moderately transparent. The clear matrix is crowded with test cells which are small but very numerous. Most of them are of rounded form, and some are very granular. No pigmented cells and no bladder cells are present.

The Mantle is moderately thick and opaque, but is not very muscular. The muscle bands are all longitudinal in direction.

The Branchial Sac is short, and its wall is thick and rather opaque. The transverse vessels are wide and all of the same size. The stigmata are rather short and rounded. The ciliated cells are distinct.

The Endostyle is conspicuous; its course is undulating.

The Dorsal Lamina is represented by a series of long tapering languets.

The Alimentary Canal is moderately large and forms a long loop.

The Post-Abdomen is very large, and is equally wide all the way down. Its end is broad and rounded.

Locality.—Christmas Harbour, Kerguelen Island, January 29, 1874; depth, 50 to 120 fathoms.

Five colonies of this species were obtained in Christmas Harbour, Kerguelen Island, at depths between 50 and 210 fathoms. They are all of much the same size, the largest being 3 cm. and the smallest 2 cm. in greatest length, but they differ somewhat in shape. Still they are all more or less elongated, have the upper end broad and rounded, and are greatly compressed (Pl. XXX. fig. 16). They look as if they had grown up between stones or in some narrow cleft, which had prevented their expansion laterally. The area of attachment is comparatively small. The colour has in places a pale slaty-blue tint.

The Ascidiozooids are distinctly visible from the outside (Pl. XXX. fig. 16). Their long bodies form opaque grey lines upon the flattened sides of the colony and extend down to the very base. They are of much the same width in all parts, and the post-abdomen is generally longer than the thorax and abdomen together.

The test is rather small in amount, and looks shrivelled and contracted. All the usual shapes of test cells are found, although the majority are ovate or globular. The branchial siphon is rather short, but the sphincter is well developed. The branchial aperture is six-lobed. The atrial aperture is circular, and is provided with a short pointed languet, placed at its anterior edge.

The branchial sac is usually considerably corrugated. The stigmata are small and closely placed. The transverse vessels have well-marked horizontal membranes (Pl. XXX. fig. 17, *h.m.*). The tentacles are numerous and rather short. The nerve-ganglion is large. It is circular in outline. The dorsal languets are very large.

The stomach is short but wide. Its wall is thrown into a series of well-marked longitudinal folds. The rectum is large. The intestinal loop is rather narrow.

The post-abdomen is as wide as the thorax. It varies greatly in length in the different Ascidiozooids. It is of a greyish-yellow colour, and is quite opaque, with the exception of a narrow undulating central clear streak which represents the lumen of

the double median septum. The reproductive organs were in an undeveloped condition in all the Ascidiozooids examined.

This species is closely allied to *Amaroucium variabile*, which was also obtained at Kerguelen Island, but the Ascidiozooids of the two species differ in the shape of the atrial languet and the stomach, and in some other details. Cunningham's *Aplidium fuegiense*, from the Strait of Magellan,[1] is also allied to, and may possibly turn out to be identical with, the present species. On account of the insufficiency of the description it is, however, impossible to determine with certainty even the genus to which *Aplidium fuegiense* belongs. A re-examination of the species is much to be desired.

Amaroucium irregulare, n. sp. (Pl. XXX. figs. 1–7).

The Colony is an irregular mass of very variable shape, but always compressed laterally. The place of attachment at the lower end may be very small or it may be as large as the rest of the colony. The upper end is usually broad and slightly convex, but may be elongated and pointed. The colour is light grey with a slight yellowish tinge. The surface is uneven but moderately smooth except at the lower end, where there is a great deal of imbedded and incrusting sand.

The length is about 3 cm., the breadth about 5 cm., and the thickness about 1 cm.

The Ascidiozooids are of moderate size and are rather numerous. They are about 6 mm. in antero-posterior length and scarcely 1 mm. across the widest part. The body is very opaque, and the division into regions is not very clearly marked. The Ascidiozooids are not arranged in systems.

The Test is soft and gelatinous. The outer layer forms a slightly firmer membrane, which is smooth and glistening. The posterior end is stiffened by imbedded sand-grains. The test cells are numerous and of various shapes, but usually more or less fusiform. There are no bladder cells present.

The Mantle is of moderate strength; the muscle bands are feeble but fairly numerous; they are nearly all longitudinal.

The Branchial Sac is small and rather opaque. The stigmata are short, and the transverse vessels are provided with slight horizontal membranes.

The Dorsal Lamina is represented by a series of short stout languets.

The Tentacles are numerous and rather large.

Locality.—Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8 F.

This species is probably present in considerable abundance in the Straits of Magellan, as there are more than a dozen specimens in the collection. The form is apparently very

[1] *Trans. Linn. Soc. Lond.*, vol. xxvii. p. 465, 1871.

variable. The typical condition seems to be a flattened cake-like mass attached by one end (Pl. XXX. fig. 1). In one case, however, it is attached by one of the flattened sides, so that the compression is from above downwards and not laterally. In other cases the shape is quite different and is very irregular, being either a lobed mass or having an elongated bent form somewhat like that characteristic of *Atopogaster elongata* (compare Pl. XXIV. fig. 3, and Pl. XXX. fig. 2).

In all cases there is an area of attachment at one end, marked by the presence of sand-grains and small stones. This region may be very small (a few millimetres across) or of considerable size (Pl. XXX. fig. 1), up to 7 cm. in length by 3 cm. in breadth; but scattered sand-grains are frequently found attached to the test even on the upper surface of the colony. The colour is a very light grey with a yellowish tint caused by the bodies of the Ascidiozooids showing through the semi-transparent test. The lower end of the colony is always of a dark colour on account of the adhering sand (Pl. XXX. fig. 1). A few of the more irregularly shaped colonies (Pl. XXX. fig. 2) have decidedly more of a yellow colour than the others, and at first I was inclined to separate these forms as a variety, but finally decided not to do so, as they seem to agree with the other specimens in all other respects. One or two of the more remarkably shaped colonies have probably been deformed from growing in chinks between stones, or in some such places where they had not room to expand in all directions.

The measurements given above are those of an average specimen. The smallest colony is 1·4 cm. in length and 1 cm. in breadth. The longest measures 9 cm., and the greatest breadth attained is nearly 7 cm.

The Ascidiozooids are placed in the test with great irregularity, and incline at various angles to the surface. The thorax and the post-abdomen are rather long (see Pl. XXX. fig. 3, *th.* and *p.abd.*), while the abdomen between is very short. The Ascidiozooids are not arranged in distinct systems, and the common cloacal apertures are not visible.

The test is softer and more pliable than in most allied forms. It becomes brittle, however, at the lower end of the colony, where there is much sand imbedded in it. In some of the colonies the smooth membrane formed by the outer layer of the test is much more distinct than in others. I am inclined to think that the specimens of a greyer colour, with fewer and larger Ascidiozooids and a distinct smooth membrane over the outer surface, are old colonies; while those with a yellowish colour, numerous Ascidiozooids, and no distinct outer layer on the test, are younger, although they may be of large size. The test cells are especially numerous in the layers of test immediately around the bodies of the Ascidiozooids. The matrix is exceedingly clear and transparent in thin sections, and shows no fibrillation. There are no vessels present, but occasionally the tip or extreme posterior end of the post-abdomen is seen cut in section in the test, and then looks exactly like the transverse section of a vessel. In some

parts of the test, near the outer surface, there are some rather larger elliptical cells with very granular protoplasm.

The musculature is most strongly developed on the thorax and on the post-abdomen; the abdomen has only a few delicate longitudinal bands. There are six well-marked lobes on the branchial siphon, and a long pointed languet is present at the atrial aperture (Pl. XXX. fig. 3, *at. l.*).

The stigmata vary in size in different branchial sacs. In many cases they are shorter and less numerous than in the piece figured (Pl. XXX. fig. 4, *sg.*).

The alimentary canal is of relatively small size (Pl. XXX. fig. 3, *abd.*, and fig. 6). The œsophagus is a narrow tube which runs directly backwards from the posterior end of the branchial sac to open into the large globular stomach (Pl. XXX. figs. 5, 6, *st.*). The wall of the stomach is thrown into a number of longitudinal folds, usually five on each side, which are clearly visible on the outer surface (Pl. XXX. figs. 5, 6, *st.*), and are seen in a transverse section (see Pl. XXX. fig. 7, *st.*) to be of considerable size. The posterior end of the stomach is slightly narrower than the anterior, and it is continued into the narrow intestine, which runs backwards for some distance in a slightly undulating course (Pl. XXX. fig. 6, *i.*). It then turns dorsally and anteriorly and passes into the rectum, a thin-walled tube of considerable size which runs anteriorly along the dorsal edge of the stomach, œsophagus, and branchial sac, and finally terminates in the peribranchial cavity. The rectum has its wall folded longitudinally in two or three places (Pl. XXX. fig. 7, *r.*), but these folds are neither so large nor so regular as those of the stomach.

The post-abdomen is large and has a small knob at its posterior end like that found in *Atopogaster elongata* (see Pl. XXIV. fig. 4, and Pl. XXX. fig. 3). The heart is placed at the end of the post-abdomen. The usual double membranous septum runs along the whole length (Pl. XXX. fig. 3, *p.abd.*), and separates two cavities in which the reproductive organs are situated.

Amaroucium irregulare, var. *concinnum*, nov. (Pl. XXX. fig. 8).

One specimen, from Station 313, differs in some respects from the other colonies of *Amaroucium irregulare* from that locality, and may consequently be recognised as a variety. It is of elliptical form (Pl. XXX. fig. 8) and is much compressed laterally. It is attached by a very small area at one of the ends, and measures 5·3 cm. in length, 3·5 cm. in breadth, and 1 cm. in thickness. It is slightly paler in colour than most of the other specimens, and has almost no sand attached to the test. The most notable feature in it, however, is that in one region, on one of the flattened sides and especially near the upper end, the Ascidiozooids are arranged in distinct circular or ovate systems like those of a *Botryllus*. There are about a dozen of these systems distinctly visible and clearly

defined (Pl. XXX. fig. 8), while others in the neighbourhood are less definite. In other parts of the colony the Ascidiozooids are apparently placed quite irregularly, as in the other specimens of the species (see Pl. XXX. figs. 1, 2). Here, as in so many other cases, it is impossible from want of material to decide whether it is most convenient to regard this form as merely an individual variation, or as a specimen of a distinct variety worthy of being named.

Amaroucium pallidulum, n. sp. (Pl. XXX. figs. 9–11).

The Colony has the form of a rudely hemispherical mass, attached by about half of the flattened lower surface, and irregularly convex above. There is slight lateral compression, and the edges are all rounded. The colour is light grey, with pale yellow patches here and there where the Ascidiozooids show through the test. The surface is uneven, and is finely roughened all over.

The length (from the base upwards) is 1·5 cm., the breadth is 3 cm., and the thickness is 2 cm.

The Ascidiozooids are fairly large and not very numerous. An average size is about 8 mm. in antero-posterior length and 1·5 to 2 mm. in greatest breadth. The body is not distinctly divided into regions, and the post-abdomen is thick. The whole body of the Ascidiozooid is of an opaque, pale, whitish-yellow colour. There is no arrangement in systems.

The Test is firm and tough. It is of a light grey colour and rather transparent. The test cells are very minute and not very numerous; there are no bladder cells present.

The Mantle is well developed and strongly muscular. Most of the muscle bands run longitudinally.

The Branchial Sac is thick-walled and opaque. The stigmata are small and rounded, and the transverse vessels are all of the same size.

The Endostyle is broad and conspicuous, and has an undulating course.

The Tentacles are numerous and closely placed. They are of two sizes, placed alternately.

The Dorsal Tubercle has a plain circular aperture, and is placed close to the peripharyngeal band.

Locality.—Station 315, January 26, 1876; lat. 51° 40′ S., long. 57° 50′ W.; depth, 12 fathoms; bottom, sand and gravel.

The single specimen of this species in the collection, is a small irregularly rounded massive colony obtained at Port William, in the Falkland Islands, from a depth of 5 to 10 fathoms. It was attached by a part only of the lower surface, the edge all round being

a free rounded projection (Pl. XXX. fig. 9). The upper surface was probably more perfectly convex in the living condition than it is now.

The Ascidiozooids modify the colour of the colony considerably, on account of their size and the transparency of the test. They are scattered irregularly over the colony, and lie at various angles to the upper surface. The anterior part of the body is of considerable breadth, but there is no external line of demarcation between the thorax and the abdomen.

The test is very compact, and is cartilaginous in consistence; it appears perfectly clear and homogeneous in sections. The test cells are much more numerous in some places than in others. Many of them are fusiform and very much elongated.

Some parts of the mantle are very strong, the musculature forming almost a continuous layer. The sphincter at the branchial aperture is strong.

The branchial sac is very opaque, and is in a lowly developed condition, the stigmata being small and the ciliated cells inconspicuous. The transverse vessels are provided with horizontal membranes (Pl. XXX. fig. 10, *h.m.*). The endostyle is larger and more conspicuous than usual. It occupies a considerable part of the ventral half of the thorax.

The tentacles are stout but not very long. There are about twenty, ten longer and ten shorter. The dorsal tubercle is rather large. The nerve ganglion, which is placed immediately behind the dorsal tubercle, is very large, and is nearly circular in outline.

The abdominal part of the body is relatively small, and the alimentary canal forms a short loop. The stomach has its wall folded longitudinally. The reproductive organs occupy the large post-abdomen. The vas deferens is very wide and is a conspicuous object in its entire length.

In some of the Ascidiozooids tailed larvæ were found. They are large, have a moderately elongated body, with very distinct pigmented sense-organs placed about two-thirds of the way back. The anterior end is rather broader than the posterior (Pl. XXX. fig. 11).

Amaroucium recumbens, n. sp. (Pl. XXIX. figs. 13–15).

The Colony is of slightly elongated form and is attached by the whole of one side to a fragment of shell. The upper one-third is wider than the lower part, and the top is rounded. The lower end is prolonged on one side to form a thin expansion attached to the shell. The surface is moderately smooth. The colour is light grey, becoming rather darker towards the lower end.

The length is 2·5 cm., the greatest breadth is 1·2 cm., the breadth of the lower narrower part is 6 mm., and the greatest thickness is 8 mm.

The Ascidiozooids are rather small, and are not numerous. They seem to be scattered irregularly over the upper part of the colony. The usual length is about 4 mm. and the greatest breadth is less than 1 mm. The thorax is relatively large, being

about 2 mm. in length and considerably wider than either the abdomen or the post-abdomen.

The Test is soft and gelatinous, especially on the upper wide part of the colony. It is of a light grey colour and is transparent. The matrix is crowded with small test cells. No bladder cells are present.

The Mantle is moderately strong. The muscle fibres are few in number but of large size.

The Branchial Sac is large and well developed. There are a large number of transverse vessels. The stigmata are small but numerous. They are narrow with rounded ends.

The Dorsal Lamina is represented by a series of tentacular languets.

The Dorsal Tubercle has a small rounded aperture which leads into a fusiform cavity lying below the nerve ganglion.

The Alimentary Canal is relatively of small size.

The Post-Abdomen is narrow but of moderate length. It is very opaque except in the middle line where there is a clear undulating streak representing the lumen of the septum.

Locality.—Station 311, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ 0″ W.; depth, 245 fathoms; bottom, blue mud; bottom temperature, 46° F.

This species is formed for a single colony obtained at the western end of the Strait of Magellan from the considerable depth of 245 fathoms. It is allied to *Amaroucium variabile* and to some other species which were found at Kerguelen Island, but in much shallower water.

The colony is somewhat club-shaped in form, but in place of standing erect and being attached by the base of the peduncle, it is recumbent, and is fixed to a broken shell by nearly the whole extent of one side (Pl. XXIX. fig. 13). There is slight lateral compression, the upper and lower sides, as the specimen lies, being flattened.

The Ascidiozooids are very distinctly visible. In the upper part of the colony there are a few entire Ascidiozooids, while in the lower stalk-like part there are a large number of detached post-abdomens (Pl. XXIX. fig. 13). These last are of an opaque dull yellowish-brown colour, and so give a darker tint to the lower part of the colony.

The test is soft and transparent, and on the top of the colony has an irregular and somewhat ragged appearance (Pl. XXIX. fig. 13). I think it is very probable that when the colony was collected, a number of the Ascidiozooids had recently died and been ejected from the test. Many of the small test cells are very much branched and prolonged into delicate tapering processes.

The sphincter at the branchial siphon is feeble, and the branchial aperture is distinctly six-lobed. There is an atrial languet present (Pl. XXIX. fig. 15, *at.l.*). The stigmata in the branchial sac are very numerous (Pl. XXIX. figs. 14, 15) and of moderate length.

The transverse vessels are large, and are provided with slight horizontal membranes (Pl. XXIX. fig. 14, *tr.*).

The endostyle is conspicuous; its course is very undulating (Pl. XXIX. fig. 15, *en.*). The nerve ganglion is large and almost globular in form.

The alimentary canal forms a narrow loop. The œsophagus is a slightly curved funnel-shaped tube (Pl. XXIX. fig. 15, *œ.*). The stomach is not large; its anterior end is wider than the posterior, and the wall is folded longitudinally. The intestine extends for a considerable distance behind the stomach (Pl. XXIX. fig. 15, *i.*), and then turns abruptly to the dorsal edge and anteriorly to pass into the long rectum which runs forwards along the dorsal edge of the abdomen and thorax (Pl. XXIX. fig. 15, *r.*).

The post-abdomen is variable in size. Some of those that lie detached in the lower part of the colony (Pl. XXIX. fig. 13) are larger than those forming parts of the Ascidiozooids. Probably the separation of the post-abdomen from the remainder of the body is connected with a process of rejuvenescence in the colony, consisting in the death and expulsion of the older Ascidiozooids and the formation of new ones from the detached post-abdomens. There was, however, no evidence in the colony examined that the latter process had commenced. Kowalevsky has shown that in *Amaroucium proliferum* a process of gemmation, resulting in the formation of new Ascidiozooids in the old colony, takes place by the breaking up of the post-abdomen after its separation from the body of an old Ascidiozooid.

A few large tailed larvæ, with almost globular bodies and two pigmented sense-organs placed close together, were found in the peribranchial cavities of some of the Ascidiozooids.

This is one of those species in which the use of the post-abdomen as a distinguishing feature between *Aplidium* and *Amaroucium* might cause an error in classification. In some of the Ascidiozooids the post-abdomen is shorter than the combined thorax and abdomen, and, therefore, judging from this character alone, the species is an *Aplidium*. The shortness of the post-abdomen, however, is merely the result of gemmation having taken place, and the species really belongs, I consider, not to *Aplidium* but to *Amaroucium* (see p. 200).

Amaroucium hepaticum, n. sp. (Pl. XXV. figs. 13, 14).

The Colony was probably of moderate size and rounded in form. It is of a pale liver-colour, and is smooth externally.

The Ascidiozooids are small, not more than 2 mm. in antero-posterior extent, and very narrow; the body is not distinctly divided into regions.

The Test is rather soft except on the outside of the colony, where it is distinctly firmer and tougher. It is of a pale grey tint internally, and becoming gradually darker, passes into a pale liver-coloured tint in the outer layer. It is almost opaque. The

matrix is homogeneous, and is crowded with small rounded test cells. There are no bladder cells and very few vessels present.

The Mantle is not strong. The muscle bands are mainly longitudinal, and are placed far apart.

The Branchial Sac is small, and contains comparatively few stigmata. The transverse vessels are wide and have no horizontal membranes. The stigmata are small round openings regularly placed.

Locality.—Unknown.

This species, like *Atopogaster informis*, is founded upon a fragment of a colony, preserved in absolute alcohol, which is unlike any other specimen in the collection, and is not labelled with any locality or date.

It is a slice measuring about 4·5 cm. in greatest length, 2 cm. in greatest breadth, and 1 cm. in greatest thickness, and has been probably cut from a colony of rounded form at least 5 cm. in height and 4 cm. in breadth.

The small Ascidiozooids are irregularly scattered through a zone of test about 1 cm. in width forming the outer layer of the colony (Pl. XXV. fig. 13). This outer layer of test is of a pale liver-colour, and the contained Ascidiozooids are opaque yellowish-brown. The Ascidiozooids do not show through, as the surface layer of test is almost opaque, consequently they do not affect the colour of the outside of the colony. The central mass of test, in which there are no Ascidiozooids (Pl. XXV. fig. 13), is of a lighter colour, being dull yellowish-grey.

The minute rounded cells in the test are exceedingly abundant, and the dark colour and opacity of the outer layers are undoubtedly due to their presence.

The whole body of the small Ascidiozooid is quite opaque (Pl. XXV. fig. 13) although the mantle is by no means very thick. The branchial sac is in a low state of development (Pl. XXV. fig. 14), and resembles closely the condition of the smallest sacs of *Atopogaster informis* (compare Pl. XXIV. fig. 13, and Pl. XXV. fig. 14).

The alimentary canal forms a comparatively short loop and is quite opaque. The reproductive organs extend for a variable distance behind the intestinal loop, and in some cases form a comparatively long narrow post-abdomen. In sections through the colony the post-abdomen is seen to be occupied by numbers of mesoderm cells placed on both sides of a double median membranous septum.

Although this species may resemble *Atopogaster informis* so distinctly in the structure of the branchial sac, still they are not at all closely allied. They differ greatly in the size of the Ascidiozooids, the condition of the test, and in various other details of structure described above.

Amaroucium lævigatum, n. sp. (Pl. XXX. figs. 12–15).

The Colony is of an irregular ellipsoidal form and is unattached. All its surfaces are rounded, and there is slight lateral compression. The colour is pale dull yellow. The surface is even and is fairly smooth all over.

The length is 3 cm., the breadth 2 cm., and the greatest thickness 1·8 cm.

The Ascidiozooids are very small and rather numerous. They are narrow, and the post-abdomen is elongated to form a narrow filament running towards the centre of the colony. The arrangement of the Ascidiozooids is irregular.

The Test is firm and solid and almost perfectly opaque. The matrix is clear and homogeneous, but it is crowded with test cells of various sizes and shapes. Many of them are of rounded form and rather large size, and are darkly coloured, others are smaller and are elongated and fusiform. There are no bladder cells.

The Mantle is moderately strong. The muscle bands are not numerous, and they run mainly in a longitudinal direction. They are distant on the thorax and feebly developed on the abdomen, but become more closely placed on the post-abdomen. The branchial aperture is six-lobed.

The Branchial Sac is long and narrow. The transverse vessels are rather wide and are all of one size. The stigmata are well developed and numerous. They vary somewhat in size.

The Tentacles are large, and are all of about the same size.

The Alimentary Canal forms a long narrow loop. The stomach is small, but has its wall folded longitudinally.

Locality.—Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth 55 fathoms; bottom, sand; bottom temperature, 47°·8 F.

The single specimen of this species was obtained at the eastern end of the Strait of Magellan, from a depth of 55 fathoms. It is a small compact colony which apparently was not attached by any part of its surface (Pl. XXX. fig. 12). Ascidiozooids are seen all over the colony, which probably lay on the sand, since dark sand-grains are found imbedded in the test at one of the ends (Pl. XXX. fig. 12). In cross section the shape of the specimen is triangular, with rounded angles and depressions on the sides. These depressions, however, are possibly the result of contraction on being put into alcohol. The colour is more of a pale yellow than a grey. At one end it is darker on account of the imbedded sand-grains.

The anterior ends of the Ascidiozooids may be seen all over the surface as very faint pale yellow spots (Pl. XXX. fig. 12). Nothing further can be made out on account of the opacity of the test. In some places the Ascidiozooids seem to be arranged in small circular systems, but elsewhere they are scattered quite irregularly.

The test is cartilaginous in consistence, and is hard and firm throughout the whole

colony. It is traversed in all directions by the long narrow Ascidiozooids which run irregularly from the surface towards the centre. The test cells are exceedingly numerous and closely placed (Pl. XXX. fig. 15, *t.c.*), and are very diverse in shape and size. The opacity of the test is in all probability due to their abundance. In some places they occur in rounded masses in which the individual cells have become more or less polygonal from mutual pressure (Pl. XXX. fig. 15, *t.c'.*). Although the body of the Ascidiozooid is opaque, the mantle is not thickened, and the musculature is not very strong. The branchial sphincter is feebly developed.

The branchial sac is usually much longer than it is broad (Pl. XXX. fig. 13), but it is small compared with the size of the body. In some cases the sac is about four times as long as it is broad, and there may be fourteen or fifteen rows of stigmata. The stigmata are distinct, but not large (Pl. XXX. fig. 14, *sg.*); they are closely placed and have well-developed ciliated cells. The endostyle is conspicuous. Its course is undulating (Pl. XXX. fig. 13, *en.*).

The alimentary canal is long and narrow. It is usually of about the same length as the branchial sac, consequently the thorax and abdomen are nearly equal in size (Pl. XXX. fig. 13). The œsophagus is a long narrow tube; it starts from the posterior end of the branchial sac, and runs directly backwards to the stomach, which is placed about the middle of the abdomen. The stomach is small and has a globular or a pyriform shape (Pl. XXX. fig. 13, *st.*). Its wall is thrown into from four to six well-marked longitudinal folds. The intestine is very long and is divided into several distinct regions. It leads backwards from the stomach as a narrow tube which runs nearly to the posterior end of the abdomen, and then opens into a short thick-walled pyriform cavity which bends ventrally and becomes continuous with a short and very narrow thin-walled tube which turns anteriorly and opens into the much wider rectum. This last region may be of great length (Pl. XXX. fig. 13, *r.*). It runs anteriorly in a slightly undulating course alongside the intestine, stomach, and œsophagus, and then courses along the dorsal edge of the branchial sac, so as to reach the atrial part of the peribranchial cavity. Consequently there may be as many as four distinct regions in the intestine:—(1) the narrow piece stretching backwards from the stomach, (2) the short wide region, (3) the thin connecting tube, and (4) the long and rather wide rectum. The third portion was not distinctly marked in the Ascidiozooid figured (Pl. XXX. fig. 13).

The post-abdomen is very long, sometimes several times as long as the rest of the body (Pl. XXX. fig. 13, *p.abd.*). It contains both male and female reproductive organs, and ends posteriorly in an irregularly rounded bulb.

In some respects the external appearance of this species suggests *Atopogaster elongata* (see Pl. XXIV. figs. 1–3), which was found in abundance at the same locality, Station 313, but the Ascidiozooids are much smaller and less conspicuous in the present species, besides which there are many of the internal details of structure in which the two forms differ.

Amaroucium colelloides, n. sp. (Pl. XXVII. figs. 9–12).

The Colony is an elongated pyriform body consisting of an irregularly ovate head, and part of a short thick peduncle. The top forms a blunted point, the sides are not flattened, and the base passes gradually into the peduncle. The colour is a dull grey, spotted with lighter grey marks caused by the bodies of the Ascidiozooids. The peduncle is darker in colour on account of adhering sand-grains. The surface is uneven and not very smooth.

The length of the head is 2·2 cm., the greatest thickness is 1·2 cm., and the thickness of the peduncle is 0·9 cm.

The Ascidiozooids are of moderate size, and consist each of an anterior part about 2 mm. in antero-posterior length and nearly 1 mm. in greatest breadth, and which consists of the branchial sac and the alimentary canal, and a posterior part, the post-abdomen, which is very long and narrow and may be traced downwards into the peduncle.

The Test is moderately firm, and is not very transparent. It is of a dull grey colour, and is formed of a homogeneous matrix in which are scattered the usual small cells of various shapes. No bladder cells are present.

The Mantle is not very strong. The muscle bands are thin and are placed rather far apart.

The Branchial Sac is small. The transverse vessels are rather wide, and are all of the same size. The stigmata are moderately long and narrow.

The Endostyle is conspicuous and has a very undulating course.

The Reproductive Organs are placed in a very long and narrow post-abdomen. They are hermaphrodite.

Locality.—Station 142, December 18, 1873; lat. 35° 4′ S., long. 18° 37′ W.; depth, 150 fathoms; bottom, green sand; bottom temperature, 47° F.

There is only one specimen of this species in the collection. It was obtained south of the Cape of Good Hope, from a depth of 150 fathoms. In external form (Pl. XXVII. fig. 9) the colony is like some of the species of *Colella*, but in its structure it is clearly one of the Polyclinidæ. The peduncle has been broken across about 8 mm. below the base of the head, but probably it was not very much longer, as the sandy condition of what remains suggests that it was situated not far from the point of attachment of the colony (Pl. XXVII. fig. 9).

The head is long and narrows considerably towards the upper end. At the base it passes gradually into the relatively thick peduncle, which was probably not more than 2 cm. in length when complete. The peduncle is firm, and is penetrated in all directions by the long narrow posterior prolongations of the Ascidiozooids in the head above. The outer layer of the peduncle has a good deal of sand imbedded in it (Pl. XXVII. fig. 9). This gives it a darker colour than the head.

The test of the head is not soft, but it is not so firm as that of the peduncle. It is of a dark grey colour and is only slightly transparent. The dull yellowish Ascidiozooids show through the superficial layer of test as lighter grey patches with a slight yellowish tinge. No common cloacal apertures are visible in the colony.

The Ascidiozooids are evidently arranged in vertical lines, which are, however, somewhat irregular in parts (Pl. XXVII. fig. 9). Their bodies are not placed at right angles to the surface, but dip inwards at various angles. Consequently in many cases the greater part of the body is visible through the surface layer of test, and measures up to nearly 2 mm. in its greatest extent (*i.e.*, antero-posteriorly). The central region of the head is occupied by the posterior prolongations of the Ascidiozooids, which run chiefly in a longitudinal direction.

The test is fairly tough, and does not show a great many cells in its matrix. The cells are of the usual forms, but are of small size.

The mantle is rather opaque, but is not strongly muscular. Over the post-abdomen it contains a number of longitudinal bands of muscle fibres. The branchial aperture is small, but is distinctly six-lobed. The endostyle is wide, and undulates greatly from side to side in its course. The branchial sac contains few stigmata, but they are of a fair size (Pl. XXVII. fig. 10, *sg.*). The transverse vessels are wide.

The alimentary viscera form an opaque mass placed close against the branchial region of the body and continuous with it; the stomach is folded longitudinally. The reproductive organs are contained in the very long and narrow post-abdomen, upon which they produce a fusiform swelling (Pl. XXVII. fig. 11). They consist of one or two large yellow ova and a number of small spermatic vesicles. The vas deferens is a conspicuous object (Pl. XXVII. fig. 11, *v.d.*). It has a remarkably undulating course.

A considerable number of tailed larvæ are present in the colony. They have the body much elongated antero-posteriorly (Pl. XXVII. fig. 12), and provided with three adhering organs in front which have a somewhat remarkable form. Two pigmented sense-organs are present; they are placed very far posteriorly (Pl. XXVII. fig. 12).

Amaroucium albidum, n. sp. (Pl. XXVI. figs. 11–12).

The Colony is an irregularly elongated mass of considerable size, attached by the lower end, and slightly compressed laterally. The widest part is about the middle, and the upper end is obtusely pointed. The surface is irregular but fairly smooth. The colour is dull white.

The length is 7 cm., the greatest breadth 4 cm., and the greatest thickness 3 cm.

The Ascidiozooids are small and inconspicuous. They are long but narrow, and are very numerous. The thorax and abdomen are short, but the post-abdomen is of great

length. The Ascidiozooids are inclined at various angles to the surface of the colony, and they are not arranged in regular systems.

The Test is hard and cartilaginous, and is quite opaque. It is of a dull whitish colour, with a slight tinge of grey internally. The matrix of the test is structureless or very slightly fibrillated in some places. It contains numerous test cells of various shapes, and a few bladder cells.

The Mantle is moderately strong. The chief muscle bands run longitudinally.

The Branchial Sac is of small size, and is very narrow. The stigmata are small and inconspicuous.

The Alimentary Canal is relatively small, and forms a narrow loop.

The Post-Abdomen is large; it extends for a considerable distance behind the intestinal loop.

Locality.—Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ W.; depth, 38 fathoms; bottom, sand and shells.

Two large colonies of this species were obtained in Bass' Strait from a depth of 38 to 40 fathoms.[1] They are elongated dirty-white masses with rounded ends, and having no external marks of importance (Pl. XXVI. fig. 11). Both specimens are attached by their lower ends to the insides of Lamellibranch shells.[2] The area of attachment is of moderate size, 2 to 3 cm. across. From the base the colony increases somewhat in size as it is traced upwards, and it becomes slightly flattened. Above the middle it tapers irregularly to the blunted apex.

The dimensions of the second colony are:—length 5·5 cm., breadth near the middle 4·5 cm., thickness near the middle 2 cm. In this specimen the thickness decreases regularly from the base of attachment to the apex. The lower end is partially incrusted with shell fragments, Polyzoa, and other foreign bodies.

The surface is marked in some places with deep grooves and depressions (Pl. XXVI. fig. 11), which may be partly the result of irregular contraction, otherwise it is fairly smooth, but it is not glistening. The colour is dull white on the projecting parts, becoming of a greyish cream-colour in the depressions. No common cloacal apertures and no systems of Ascidiozooids are visible on any part of the colony.

The Ascidiozooids are very narrow, but of considerable length. On cutting open the colony their filiform bodies may be seen penetrating the test in all directions. They are of an opaque dirty-white colour, sometimes with a yellowish tinge, and are very numerous. They probably help in giving the colony its whiteness and opacity, since the test around them is slightly grey in hue, and is not so opaque as the surface of the colony.

The test is very solid and tough, and the outer layer is rather stronger than

[1] That is the depth at the Station, but the parchment label in the bottle is marked 85 fathoms.

[2] A species of *Pectunculus* (?).

the rest. The test cells are fairly large and numerous (Pl. XXVI. fig. 12, *t.c.*); triangular and stellate forms with very long rays are the most common, but rounded granular ones are also present. The bladder cells are not numerous, and they are rather small.

The mantle is strong and opaque. It contains pigment cells, and the muscle fibres are of large size.

The post-abdomen is much larger than any other part of the body, and it is the most prominent feature in sections (Pl. XXVI. fig. 12, *p.ab.*) and in teased preparations of the colony. It is an elongated thread-like body of much the same width throughout, and quite opaque. At its posterior termination there is a slight knob resembling a rudimentary vascular appendage. In sections (Pl. XXVI. fig. 12, *p.ab.*) the post-abdomen is seen to be divided throughout its entire length by the usual double septum, on each side of which lies an opaque cellular mass in which the reproductive elements are formed.

Amaroucium nigrum, n. sp. (Pl. XXXI. figs. 17–19).

The Colony is irregularly club-shaped. It is attached by a small base from which it gradually enlarges to a much wider upper end. It is not compressed laterally. The upper end has an obliquely truncated appearance. The surface is uneven. The colour is black.

The length is 1·6 cm., the greatest breadth is 5 mm., and the greatest thickness is 4 mm.

The Ascidiozooids are of moderate size, but are few in number. They are placed vertically in the colony, and their anterior ends form small projections on the surface of the upper end; otherwise they are not visible externally.

The Test is firm and cartilaginous. It is of a very dark grey-brown colour internally, and is black on the surface. It is quite opaque. The test cells are very abundant, and are mostly of elongated, fusiform, and branched shapes. They are all very granular, and some of them are of large size, and are pigmented. No bladder cells are present.

The Mantle is thick and opaque, and the musculature is well developed. The muscle bands are mainly longitudinal in direction, and they are rather wide.

The Branchial Sac is small, and is not well developed. The stigmata are short and rounded.

Locality.—Royal Sound, Kerguelen Island; depth, 28 fathoms.

A single specimen of this remarkable looking species was obtained at Royal Sound, Kerguelen Island, from a depth of 28 fathoms. It is a small black colony of elongated form, tapering from a wide irregularly shaped upper end downwards to a small area of attachment at the opposite extremity (Pl. XXXI. fig. 17). The lower part, or stalk, is irregular and slightly twisted. No common cloacal aperture is visible. The colour on

the edges, when held to the light, is a very dark brown, but on the surface it looks quite black.

The test is hard and tough. In thin sections it is transparent, but in mass is quite opaque. The structureless matrix is densely crowded with test cells. In some places they are so numerous as almost to touch one another (Pl. XXXI. fig. 18, *t.c.*). These test cells are nearly all spindle-shaped or stellate, with large central nuclei, and with the protoplasm so full of small dark granules that it might almost be called pigmented. In addition, however, there are larger cells of ovate or globular form which are much more deeply coloured and are true pigment corpuscles. The pigment granules are dark brown or nearly black in colour.

Each longitudinal muscle band in the mantle has four to eight fibres (Pl. XXXI. fig. 19, *m.b.*), and these fibres are exceptionally broad. Some parts of the mantle are slightly pigmented (Pl. XXXI. fig. 19, *p.c.*). The branchial sac is thick walled and opaque, and the stigmata are inconspicuous.

The alimentary canal is moderately large. The stomach is rounded, and its wall is folded longitudinally.

The post-abdomen is short, and in the Ascidiozooids examined the reproductive organs were in an undeveloped condition.

Psammaplidium, n. gen.

Colony incrusting, massive, or lobed.
Systems inconspicuous.
Ascidiozooids usually small, not much elongated, and not distinctly divided into regions.
Test thick, and greatly strengthened by imbedded and incrusting sand-grains and other foreign bodies which form a great part of its bulk.
Branchial Sac small, and not well developed.
Post-Abdomen usually short.

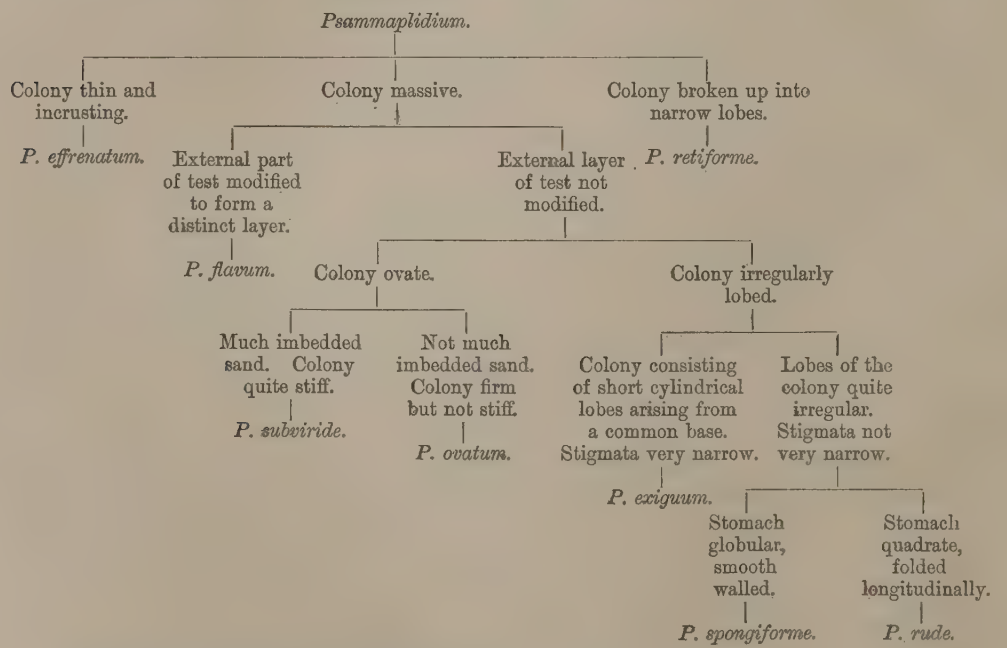
I have separated this group of species from the other Polyclinidæ on account of the very abnormal condition of the test which they exhibit. This region of the colony in all of these species contains, in a more or less marked degree, sand and shell fragments, &c., and these foreign bodies constitute, in most cases, a very considerable part of the investing mass. This sand is not merely incrusting, but the grains are actually imbedded in and surrounded on all sides by the test substance. Evidently in this genus the test has the power, during its whole development, of taking up foreign particles in large numbers and of finally growing over them, so that they come to be placed in its interior. This power is of course seen, to a limited extent, in the region of the test which forms the base of attachment in any fixed colony, and in the branched hairs

which are prolonged from the outer surface of the test in the case of most Molgulidæ and some Cynthiidæ amongst the Simple Ascidians, and in *Polyclinum sabulosum*, Giard, a member of the present family. In the description of the last named form, Giard[1] makes no mention of imbedded sand grains in the test, and consequently we may infer that the sand is merely adhering to the surface of the hair-like processes which he describes. I think it is probable that von Drasche's *Aplidium asperum* belongs to the present genus. He does not figure a section of the test, but from his description[2] it appears that there are many imbedded sand grains. It differs from all the Challenger species.

One result of the presence of imbedded sand in this genus is that the colony is rendered hard, brittle, and opaque. The Ascidiozooids are generally not visible externally, and are in some cases rather difficult to dissect out both on account of their small size and because of the surrounding sand grains.

The condition of the stomach varies in the genus; in some cases it is smooth (*Psammaplidium spongiforme*), in others it is folded longitudinally (*Psammaplidium incrustans*).

In external form also the species vary greatly, as is shown in the following synoptic table of the genus.[3]


Psammaplidium.
Colony thin and incrusting.
Colony massive.
Colony broken up into narrow lobes.
P. effrenatum.
External part of test modified to form a distinct layer.
External layer of test not modified.
P. retiforme.
P. flavum.
Colony ovate.
Colony irregularly lobed.
Much imbedded sand. Colony quite stiff.
Not much imbedded sand. Colony firm but not stiff.
Colony consisting of short cylindrical lobes arising from a common base. Stigmata very narrow.
Lobes of the colony quite irregular. Stigmata not very narrow.
P. subviride.
P. ovatum.
P. exiguum.
Stomach globular, smooth walled.
Stomach quadrate, folded longitudinally.
P. spongiforme.
P. rude.

[1] Recherches sur les Asc. Comp. ou Synascidies, *Archives d. Zool. expér.*, t. i. p. 643.

[2] Die Synascidien der Bucht von Rovigno, p. 26.

[3] To these eight species must be added a ninth, *Psammaplidium pyriformis* (see Appendix B. at the end of this Report). It is closely allied to *Psammaplidium subviride*, but differs from that species in its pyriform shape, its colour, and the condition of its mantle and branchial sac.

Psammaplidium spongiforme, n. sp. (Pl. XXXII. figs. 1–5).

The Colony is an irregularly lobed mass of large size. It is attached by a comparatively small area, and from this base rise several closely placed large flattened expansions with irregularly lobed free ends. All of the edges and processes are rounded. The surface is irregular, rough, and sandy. The colour is a yellowish-grey, the colour of the sand.

The length of the entire colony is 6 cm., the greatest breadth is 10 cm., and the greatest thickness 4 cm.

The Ascidiozooids are very minute, and are not visible on the outside of the colony; and, on account of the enormous quantity of sand imbedded throughout all parts, it is rather difficult to discover them even when the colony is dissected. They do not seem to be arranged with regularity, but circular common cloacal apertures are present, chiefly on the upper parts of the expansions and lobes. The bodies of the Ascidiozooids are about 1 mm. in length and 0·3 mm. in breadth. They are not divided externally into regions.

The Test is solid and firm, but very brittle. It is closely packed in all parts with imbedded sand-grains. The test cells are numerous but very small. The matrix is clear and homogeneous. No bladder cells are present.

The Mantle is moderately thick and muscular. The muscle bands are all longitudinal in direction, and are not distant.

The Branchial Sac occupies about one half of the length of the body. The stigmata are not large, and they are rather inconspicuous. They are of an elliptical form with rounded ends.

The Endostyle is large and conspicuous. Its course is undulating.

The Alimentary Canal forms a loop of considerable size. The stomach is globular and smooth walled. The rectum is relatively wide.

The Post-Abdomen is very short and is not separated from the intestinal loop. It contains both male and female reproductive organs.

Locality.—Port Jackson, Australia, April 1874; depth, 7 fathoms.

A single specimen and some fragments of this large and striking species were obtained at Port Jackson, Australia, from shallow water. The colony is very like a Sponge. It consists of four large irregular flabelliform expansions united at their lower ends where they have a common base of attachment (Pl. XXXII. fig. 1). The upper ends and free edges of these expansions bear irregularly rounded lobes or knobs. The imbedded sand-grains are so numerous that the colony looks as if it were entirely composed of sand. This is the cause of the rough surface and of the colour. A few shell fragments and other foreign bodies are attached or imbedded at the lower end of the colony near the base of attachment. The common cloacal apertures are numerous (Pl. XXXII. fig. 1).

They are all wide open and are each about 1·5 mm. in diameter. Probably the stiffness of the test caused by the sand prevents the apertures being closed.

When a section is made across one of the lobes of the colony it is seen that the Ascidiozooids are placed at right angles to the surfaces and extend from each side about one-third of the way inwards, while the central and remaining third is even more sandy than the outer surface.

The Ascidiozooids are very minute, although the colony is of such large size, and as they are surrounded on all sides by grains of sand, many of them of about their own size, it is rather difficult to make them out. When removed from the test and cleared of sand they are found to be cylindroidal in shape (Pl. XXXII. fig. 2). There is no separation into regions, and the breadth is very much the same all along the body. The thorax is usually about half the total length, and the abdomen the remainder; the post-abdomen is exceedingly short (Pl. XXXII. figs. 2, 5). So much imbedded sand is present in this species that the amount of test substance is very small relatively to the size of the colony. There is far more sand than test in the mass which invests the Ascidiozooids. The presence of this sand makes the test firm but brittle, changes its colour, and renders it quite opaque.

The branchial siphon is short, and the aperture is surrounded by six short lobes (Pl. XXXII. fig. 2). The atrial aperture is provided with a languet.

The branchial sac is rather thick walled and opaque. In most cases the stigmata are small and rounded, and both the transverse and the fine longitudinal vessels are wide (Pl. XXXII. fig. 4, *tr.*), but in one of the Ascidiozooids examined the stigmata were found to be larger and more numerous and the vessels much smaller than usual (see Pl. XXXII. fig. 3, *tr.*). The endostyle is very wide (Pl. XXXII. fig. 2, *en.*).

The œsophagus is short, and leads straight backwards to the large globular stomach (Pl. XXXII. fig. 5, *st.*) which lies on the ventral edge of the abdomen about half way back. The wall of the stomach is thick, but is not folded. The intestine leads back from the stomach for some distance, and then turns dorsally and anteriorly to become the rectum (Pl. XXXII. fig. 5, *i.* and *r.*). The intestine varies in calibre; on leaving the stomach it widens for a short distance, then narrows and then finally widens again before turning dorsally. The loop between the intestine and the rectum is moderately wide, and the abdomen as a whole is about as large in every way as the thorax. The rectum is long and is very conspicuous on account of the dark-coloured balls of fæcal matter which it contains (Pl. XXXII. figs. 2, 5, *r*). It varies in calibre according to the amount of its contents.

The post-abdomen forms merely a small rounded projection on the lower end of the intestinal loop (Pl. XXXII. fig. 5, *p.ab.*). The ova and the spermatic vesicles are closely placed and lie alongside one another. The vas deferens was not visible in the Ascidiozooids examined. No larvæ were found.

Psammaplidium effrenatum, n. sp. (Pl. XXXII. figs. 6, 7).

The Colony is an irregular incrusting mass of large size. It is attached by an extended base to a dead fragment of coral, and does not attain any great thickness. The surface is irregular and rough. The colour is dark brown.

The length is about 7·5 cm., the breadth 4 cm., and the usual thickness 8 mm.

The Ascidiozooids are of small size, and are not much elongated. They are fairly numerous and are placed rather closely over the upper surface of the colony, an arrangement in systems being visible in some places. The body is usually about 2·5 mm. in length and less than 1 mm. in greatest breadth. The post-abdomen is distinctly marked off from the anterior part of the body.

The Test is relatively small in amount and contains great quantities of imbedded sand grains of a dark colour. The matrix where free from impurities is clear and transparent and of a light grey tint. The test cells are small and inconspicuous. They are not numerous, but show the usual variety of form. No bladder cells are present.

The Mantle is thick and opaque, and the musculature is moderately strong. Most of the muscle bands run longitudinally.

The Branchial Sac is small, and is not well developed. The stigmata are few in number and of rounded form. The ciliated cells are inconspicuous.

The Endostyle is large and its course is undulating.

The Alimentary Canal forms a long narrow loop. The stomach is relatively small, and the rectum is large.

The Post-Abdomen is not large. It is narrow and tapers posteriorly.

Locality.—Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2 F.

Two broken colonies of this species were obtained off the east coast of South America, at a depth of 600 fathoms. They are large incrusting masses of a dull brown colour (Pl. XXXII. fig. 6). The two specimens differ slightly in their colour, one is of a reddish-brown and the other is a dark grey-brown. In the former the Ascidiozooids are of a yellow colour, while in the latter they are opaque white.

The colony does not rise to any height above the place of attachment, but it becomes thicker at the free edges where it has grown beyond the coral which it surrounds. The upper surface is of large extent, and is flat or slightly convex. No common cloacal apertures are visible. In some places the Ascidiozooids (which are only visible as slight elevations) seem to be arranged in irregular lines which resemble the elongated systems found in the genus *Botrylloides*, but in other parts there is no definite arrangement (Pl. XXXII. fig. 6).

The numerous sand grains imbedded in the test cause its stiffness, give it its dark

colour, make the surface rough, and render the whole colony opaque. On making a section of the colony the Ascidiozooids, which are easily removed, are found to lie in small cavities separated by narrow partitions formed of test substance and sand grains. The Ascidiozooids although small are conspicuous on account of the contrast between their light yellow colour and the dark surrounding test. They are placed nearly at right angles to the upper surface. The test cells are granular and are generally of branched forms, but they are not pigmented and are usually very inconspicuous.

The mantle is fairly muscular over all parts of the body (see Pl. XXXII. fig. 7). The branchial aperture is distinctly six-lobed, and the sphincter is well developed. The wall of the branchial sac is rather thick and opaque.

The atrial aperture is circular and has no lobes and no languet. It is placed on the dorsal edge at some distance from the branchial aperture. In this respect this species resembles the genus *Aplidium*.

The stomach is moderately large. It is globular, and has its wall slightly folded longitudinally. The spermatic vesicles are of considerable size. They are ovate or spherical in form, and the vas deferens is conspicuous.

Psammaplidium rude, n. sp. (Pl. XXXI. figs. 1–4).

The Colony is an irregularly lobed sandy mass. It is incrusting and is attached by a broad base. The upper surface is wide and usually flattened, with low projections or knobs. The surface is uneven and rough. The colour is greyish-yellow, the colour of the sand.

The length is about 1·5 cm., the greatest breadth is 2·5 cm., and the thickness is 1·5 cm.

The Ascidiozooids are not visible on the outside of the colony, and no common cloacal apertures are to be seen. The body is about 3 mm. in length and scarcely 1 mm. in breadth. The thorax, which is about 1·5 mm. in length, is indistinctly separated from the rest of the body.

The Test contains a large amount of imbedded and incrusting sand, which renders it stiff but brittle and quite opaque. The matrix is clear and structureless. The test cells are minute and not very numerous. No bladder cells are present.

The Mantle is thin and transparent, but fairly muscular. On the thorax the muscle bands are mainly transverse in direction, and are branched so as to form an irregular network. On the post-abdomen the muscle bands run longitudinally.

The Branchial Sac is large and well developed. The transverse vessels are moderately wide, and all of the same size. The stigmata are numerous; they are well developed, and are arranged with regularity. The ciliated cells are distinct.

The Dorsal Lamina is represented by a series of very short stout tentacular languets.

The Tentacles are long and slender.
The Alimentary Canal forms a long narrow loop.
The Post-Abdomen is not large.
Locality.—Unknown.

There are about half a dozen irregular and more or less fragmentary colonies of this species in the collection. The locality where they were obtained is unknown.

The shape of the colony appears to be quite indefinite. It forms irregular incrusting masses from 1 cm. to 2 cm. in height, and of varying extent and thickness (Pl. XXXI. figs. 1, 2). No traces of cloacal apertures or of any arrangement of Ascidiozooids in systems is visible. The dimensions given in the above description are those of one of the larger specimens in the collection, but probably it is not a complete colony.

The test is penetrated in all parts by sand grains, which are so abundant that the colony both outside and in sections looks as if it were merely a mass of sand (Pl. XXXI. figs. 1, 2). The roughness, the opacity, the colour, and the stiff and brittle condition of the test are all due to the presence of the imbedded sand grains. The investing mass around the Ascidiozooids contains more sand than test substance, and the test where free from impurities is clear and transparent.

The musculature of the mantle over the thorax (Pl. XXXI. fig. 3, *m.b.*) is rather like that of some of the Ascidiidæ amongst Simple Ascidians. The six lobes around the branchial aperture are very large and distinct (Pl. XXXI. fig. 3, *br.*).

The atrial aperture is placed on the dorsal edge, at a considerable distance from the anterior end. It is circular and has no lobes on the margin (Pl. XXXI. fig. 3, *at.*) A long tapering atrial languet (*at.l.*) is present on its anterior edge between it and the branchial aperture. The transverse muscle bands are placed with regularity on the sides of the body (Pl. XXXI. fig. 3, *m.b.*), but form a network on the ventral edge over the endostyle. The mantle is generally very transparent, but in some of the Ascidiozooids it is found to be considerably pigmented.

The transverse vessels of the branchial sac are provided with strong muscle bands (Pl. XXXI. fig. 4, *m.f.*), and they are all joined to the mantle by connectives. The stigmata at the ventral end of each row become much smaller, so as to allow the transverse vessels to expand into large triangular areas. At the dorsal edge of the sac the stigmata are not interrupted by a dorsal lamina (Pl. XXXI. fig. 4) but pass continuously from one side to the other between the languets.

The endostyle is large and conspicuous. Its course is undulating. The dorsal languets are remarkably short and stout (Pl. XXXI. fig. 4, *l.*); their ends are blunt. The nerve ganglion is large and of elliptical form. It is placed half way between the branchial and atrial apertures and just in front of the atrial languet (Pl. XXXI. fig. 3, *n.g.*).

The œsophagus is long and narrow, and runs posteriorly to open into the large quadrate stomach. The walls of the stomach are moderately thick and are thrown into a few slight longitudinal folds. The intestine is long and thin walled. It runs posteriorly from the stomach for a considerable distance and then turns abruptly to the dorsal edge and anteriorly so as to form a narrow loop. The rectum is very like the intestine. In some cases it is wide, when distended with food matter. The anus is placed behind the middle of the branchial sac, usually about two-thirds of the way down from the anterior end. It is a small aperture with a thickened and reflected margin.

The spermatic vesicles are globular in form. The vas deferens is not so large and conspicuous as is usual amongst Compound Ascidians. In several of the Ascidiozooids examined mature ova were found in the peribranchial cavity, usually very far forward, close to the branchial aperture, but no embryos or larvæ were seen.

Psammaplidium subviride, n. sp. (Pl. XXXI. figs. 5–10).

The Colony has an irregularly rounded or ovate form. It is attached by the lower end and is not compressed laterally. The surface is even but is slightly roughened all over. The colour is a pale opaque greenish-grey.

The length is 2·5 cm., the breadth is 1·3 cm., and the thickness is 1 cm.

The Ascidiozooids are rather small but numerous. They are scattered evenly all over the surface, and are not arranged in systems. They lie at right angles to the surface of the colony, but their bodies are usually not much elongated.

The Test is hard and firm. It contains great quantities of imbedded sand grains in all parts. Where free from impurities it is clear and transparent, and is of a pale grey colour. The test cells are abundant. They are mostly of rounded form and have granular protoplasm. No bladder cells are present.

The Mantle is thin and its musculature is feeble. The narrow muscle bands run longitudinally.

The Branchial Sac is well developed. The transverse vessels are wide. The stigmata are narrow and exceedingly long. The ciliated cells are rounded and not very conspicuous.

The Endostyle is wide. Its course is undulating.

The Dorsal Lamina is represented by a series of short horn-like languets.

The Alimentary Canal forms a long and very narrow loop. The stomach is small but the intestine is large.

The Post-Abdomen is very variable in size. It is always narrow. It contains both male and female reproductive organs.

Locality.—Station 142, December 18, 1873; lat. 35° 4′ S., long. 18° 37′ W.; depth, 150 fathoms; bottom, green sand; bottom temperature, 47° F.

Nine colonies, some of them fragmentary, of this species were obtained off the Cape of Good Hope, at a depth of 150 fathoms. Some of them are rather irregular in form and they are all incrusted with sand (Pl. XXXI. fig. 5). The colour, which is due mainly to the sand grains in the test, is light grey with a distinct greenish tint. Some of the colonies have more imbedded and incrusting sand than others, the result being that they are harder and rather darker and show no traces of Ascidiozooids. In all cases the colony is quite opaque.

Where they are visible the Ascidiozooids show as circular, less opaque, areas rather less than 1 mm. in diameter. They are closely placed, and occupy the whole outer surface of the colony with the exception of the lower end where it is attached.

The test is occupied in all parts by the imbedded sand grains, Foraminifera shells, Sponge spicules, and other foreign bodies, so that very little of the test substance can be seen in sections (see Pl. XXXI. fig. 9). In some places the granular test cells are very abundant.

The mantle is transparent in all parts of the body, and the musculature is as strong on the abdomen and post-abdomen as on the thorax. The branchial siphon is long (Pl. XXXI. fig. 7), and the aperture is distinctly six-lobed. The sphincter muscle is well developed. The atrial aperture is provided with a very large atrial languet (Pl. XXXI. fig. 7).

The stigmata of the branchial sac are remarkably long (see Pl. XXXI. fig. 6, *sg.*) and resemble those of *Colella pedunculata* amongst the Distomidæ. The dorsal languets are very short (Pl. XXXI. fig. 8); and the endostyle though wide is not conspicuous.

The œsophagus runs straight backwards and opens into the small narrow stomach, the wall of which is folded longitudinally. The intestine is nearly as wide as the stomach. It runs posteriorly for a considerable distance after leaving the stomach, and then turns abruptly to the dorsal edge and anteriorly to become the rectum. The loop thus formed is exceedingly narrow. The rectum is large and thin-walled.

The post-abdomen is in some Ascidiozooids almost absent, while in others it is a long and narrow region of the body (Pl. XXXI. fig. 10). The ova (*o.*) occur about the middle of its length, while the small ovate spermatic vesicles are placed more posteriorly (Pl. XXXI. fig. 10, *t.v.*) The vas deferens (*v.d.*) is large and conspicuous.

Psammaplidium exiguum, n. sp. (Pl. XXXI. figs. 11–12).

The Colony is in the form of one or more short cylindrical projections from a common irregular incrusting base. The upper end is more or less rounded. The surface is sandy and rough. The colour is dark grey.

The length, excluding the common base, is 6 mm., the breadth 4 mm., and the thickness 3 mm.

The Ascidiozooids are of fair size, and not numerous. There is probably a common cloacal aperture on the summit of each of the projections, and the Ascidiozooids are arranged in a group round these.

The Test is full of imbedded sand grains which render it opaque, hard, and brittle. The matrix is clear and homogeneous. The test cells are abundant and of fair size. No bladder cells are present.

The Mantle is fairly thick and muscular.

The Branchial Sac is rather small and thick walled. The transverse vessels are wide, and all of one size. The stigmata are narrow but fairly regular.

The Endostyle is wide and conspicuous. Its course is undulating.

Locality.—Station 141, December 17, 1873; lat. 34° 41′ S., long. 18° 36′ W.; depth, 98 fathoms; bottom, green sand; bottom temperature, 49°·5 F.

A single specimen of this species was obtained off the Cape of Good Hope from a depth of 98 fathoms. It is a small irregular sandy mass (Pl. XXXI. fig. 11), and in external appearance seems as if it were closely allied to *Psammaplidium subviride*. The two species, however, differ greatly in their branchial sacs (compare Pl. XXXI. fig. 6 with Pl. XXXI. fig. 12). The colour, texture, roughness, and opacity of the colony are all due simply to the presence of the sand grains, Foraminifera shells, and other foreign bodies.

The Ascidiozooids are scarcely visible externally, and are rather deeply placed in the colony. They are difficult to find on account of the imbedded sand surrounding them. The test cells are mostly of rounded form and have granular protoplasm.

In the branchial sac the stigmata are narrower than the fine longitudinal vessels (Pl. XXXI. fig. 12, *l.v.*). The ciliated cells are distinct and have pointed free ends. The cilia are very long. The wide transverse vessels are provided with muscle fibres (Pl. XXXI. fig. 12, *tr.*).

Ova are present in the post-abdomen, but no male reproductive organs are visible. Well developed tailed larvæ were found in the peribranchial cavity of one Ascidiozooid.

Psammaplidium ovatum, n. sp. (Pl. XXXI. figs. 13–16).

The Colony is an irregularly rounded mass fixed by one end and having the upper part broad and convex. The surface is even, but roughened all over. The colour is a dull dark grey.

The length is 2·3 cm., the breadth 1·2 cm., and the thickness 9 mm.

The Ascidiozooids are fairly large and numerous. They are scattered over the upper surface of the colony and seem to have no arrangement in systems. They lie generally with their antero-posterior axis perpendicular to the surface of the colony. The body is

about 4 mm. in length and scarcely 1 mm. in greatest breadth. The post-abdomen is much narrower than the anterior portion of the body, but the thorax and abdomen are not distinctly separated.

The Test is moderately firm and tough. There is a certain amount of incrusting and imbedded sand, but not sufficient to render the mass stiff or brittle. In the interior of the colony the test is of a light grey colour and semi-transparent. The matrix is clear and structureless. The test cells are not very abundant, and are mostly small but irregular and much branched forms. No bladder cells are present.

The Mantle is strong and the musculature is well developed. Over the anterior part of the body both longitudinal and transverse muscle bands are present, while in the post-abdomen they are all longitudinal and are rather closely placed.

The Branchial Sac is large and well developed. The transverse vessels are moderately wide and are provided with muscle fibres. The stigmata are fairly long and are placed with regularity.

The Tentacles are long and thin. They are of two sizes.

The Alimentary Canal is relatively of very small size, and forms a short loop.

The Post-Abdomen is long and narrow.

Locality.—Torres Strait, north of Australia; depth, 3 to 11 fathoms.

Two colonies of this species were obtained in shallow water off Cape York at the northern extremity of Australia. They differ somewhat in shape, the one being ovate with the long axis vertical (Pl. XXXI. fig. 13), and the other roughly hemispherical with the long axis horizontal. The dimensions given above are those of the former specimen, the latter measures 1·2 cm. in length, 2·5 cm. in breadth, and 1·5 cm. in thickness.

No common cloacal apertures are visible on either of the colonies. The Ascidiozooids are seen externally as small circular areas slightly elevated above the general surface (Pl. XXXI. fig. 13). In some places the open branchial apertures are visible. The shape of the Ascidiozooid is remarkable. The thorax and abdomen form a single cylindrical mass, tapering posteriorly into the long narrow post-abdomen (Pl. XXXI. fig. 15, *p.abd.*).

The amount of sand imbedded in the test is not nearly so great as in the case of some allied species (*e.g.*, *Psammaplidium spongiforme* and *Psammaplidium subviride*). It is enough, however, to render the colony opaque and roughen its outer surface. Some of the test cells are very coarsely granular, and a few are slightly pigmented. The transverse muscle bands in the mantle are very well marked (Pl. XXXI. fig. 15, *m.*). The lobes around the branchial aperture are distinct, and the sphincter is well developed (Pl. XXXI. fig. 15).

The endostyle is narrow, but has a very undulating course. In the young Ascidiozooid, however, where there are only three rows of stigmata in the branchial sac, the endostyle is quite straight (Pl. XXXI. fig. 16, *en.*). The interstigmatic vessels

of the branchial sac are narrow (Pl. XXXI. fig. 14, *l.v.*). Some of the tentacles are very long. They project for a considerable distance beyond the branchial aperture, and then are directed anteriorly.

Psammaplidium retiforme, n. sp. (Pl. XXXII. figs. 8–10).

The Colony consists of a number of elongated, club-shaped or wedge-shaped masses, compressed laterally and united together by a narrow irregular and branched creeping stolon. The upper ends of the flattened masses are usually broad and rounded. The lower ends where they join the stolon are narrow. The surface of the whole colony is irregular and slightly rough from the presence of adhering sand particles. The colour is a dull greyish-buff.

The average length of one of the masses forming the colony is 2·5 cm., and the breadth is 7 mm. at the widest part; the thickness is about 2 mm.

The Ascidiozooids are not visible on the outside of the colony, which is quite opaque. A small number of them are found in each of the separate parts of the colony. They are placed vertically and are of moderate size.

The Test is small in amount. It is firm and rather tough, of a whitish-grey colour where free from sand and Ascidiozooids, and rather opaque. Its outer layer contains imbedded sand grains and great quantities of siliceous Sponge spicules and Diatoms. The test cells are minute and not numerous. The matrix is clear and structureless. There are no bladder cells present.

The Mantle is fairly thick but not opaque. The muscle bands are strong but distantly placed.

The Branchial Sac is large and well developed. The transverse vessels are numerous, moderately wide, and all of the same size. The stigmata are closely placed and arranged with regularity.

The Tentacles are large and numerous, they are so closely placed that their bases nearly touch one another.

The Alimentary Canal is of moderate size. The stomach is folded longitudinally, and the rectum is wide and thin-walled.

The Post-Abdomen is long and narrow, and contains both male and female reproductive organs.

Locality.—Off Christmas Harbour, Kerguelen Island, January 29, 1874; depth, 50 to 120 fathoms.

One large colony and some fragments of this remarkable form were obtained off Christmas Harbour, Kerguelen Island, from a depth of 50 to 120 fathoms. It has a superficial resemblance to the Clavelinidæ amongst Simple Ascidians, and is certainly

very different in external appearance from all other known Compound Ascidians (see Pl. XXXII. fig. 8).

The Ascidiozooids occupy flattened elongated masses varying from 4 mm. to 3 cm. in length, and from 2 mm. to 8 mm. in breadth at the broadest part. These are connected by branching stolons so as to form a rude network (Pl. XXXII. fig. 8). Probably the stolon was slightly attached to some foreign object, and the remainder of the colony lay in a recumbent or semi-erect position. Its sandy condition suggests that it probably trailed over a sandy bottom. Each of the flattened masses rising from the stolon contains a few Ascidiozooids which may be regarded as forming a system. No common cloacal apertures, however, are visible. If present, they are probably placed in the middle of the upper end.

The test does not become thickened in any part of the colony. It merely forms a thin but tough skin around each group of Ascidiozooids, and is greatly strengthened by imbedded foreign bodies. Some of the Sponge spicules attached to the surface are of large size, from 1 cm. to 2 cm. in length.

The branchial siphon is well formed, and the aperture is surrounded by six elongated lobes (Pl. XXXII. fig. 10, *br.l.*). The sphincter is well developed. The atrial aperture is provided with a short languet. The stigmata though not large are well formed (Pl. XXXII. fig. 9, *sg.*). The ciliated cells are distinct, and have pointed free ends. The rectum is filled with fragments of Diatoms, Sponge spicules, and minute sand grains.

The ova are large and of a bright yellow colour. The vas deferens is large and conspicuous. The spermatic vesicles are rather small and of a pale colour; they are ovate in shape.

In some of the Ascidiozooids tailed larvæ were found in the peribranchial cavity. They have each two pigmented sense-organs placed close together near the posterior end of the body. Large groups of ectodermal processes are present at the anterior end.

Psammaplidium flavum, n. sp. (Pl. XXXII. figs. 11–13).

The Colony is a small irregularly hemispherical mass attached by a wide base. The upper end is convex. The colour is a dull opaque yellowish-brown. The surface is even but finely roughened all over.

The length is 1 cm., the breadth 1·5 cm., and the greatest thickness 1·4 cm.

The Ascidiozooids are rather small and not very numerous. They are not visible until the colony is cut open. The usual size is about 3 mm. in length and less than 1 mm. in greatest breadth. They are quite opaque and are not divided into regions externally.

The Test is hard and firm, but not tough. It is of a yellowish-brown colour externally, but dull grey in the interior of the colony; it is quite opaque all through. The matrix

is densely crowded with test cells of rather large size and various shapes. There are also grains of sand in considerable quantity imbedded in the test, and masses of pigmented test cells are present in the outer layer.

The Mantle is well developed, and the muscle bands are strong. Most of them run in a longitudinal direction.

The Branchial Sac is long and narrow. The transverse vessels are all of one size. The stigmata are small and inconspicuous.

The Alimentary Canal is relatively small and forms a short loop.

The Post-Abdomen is large. It is as wide as the anterior part of the body.

Locality.—Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2 F.

This species does not look like a Compound Ascidian when seen from the outside (Pl. XXXII. fig. 11). It is peculiarly interesting on account of the modification of the external layer of the test, and also on account of the very considerable depth (600 fathoms) from which it was obtained.

It is attached by a large spreading base which extends somewhat beyond the edge of the colony and is of a dark grey colour. From this rises a low dome-shaped mass of a dull yellowish-brown colour and with a finely roughened surface. It is perfectly opaque, and no Ascidiozooids or marks indicating their presence are visible (Pl. XXXII. fig. 11).

On making sections of the colony it is found that the colour is due to the outer layer of test, the inner parts being of a dark opaque grey. In this inner region the dull yellow bodies of the Ascidiozooids are seen penetrating the test in all directions. They are not arranged with any regularity, and they are inclined at various angles to the surface.

The test although stiff is brittle, probably a result of the numerous imbedded sand grains, shell fragments, sponge spicules, &c. The test cells are large and granular; they vary greatly in shape. The most remarkable point, however, in the test is the presence in the outer layer of a great number of closely placed masses of large granular cells (Pl. XXXII. fig. 13, *tc′*.); the cell masses are usually of a rounded form, or polygonal from mutual pressure (see Pl. XXXII. fig. 12). It is these masses which, by making the test above them project slightly, form the roughness which is visible on the external surface of the colony. At first I was inclined to regard them as enlargements upon vessels in the test corresponding to the terminal knobs found in the outer layer of the test of some species of *Culeolus*[1] and some of the Botryllidæ (see Pl. III. fig. 9, *t.k.*). A careful examination of the test, however, showed that no vessels were present, and that the cavities in the test matrix, in which the masses of cells were placed (Pl. XXXII. fig. 12), had no tubes leading from them, but were closed upon all sides. Therefore I am now disposed to consider the cells as modified test cells and not as blood-corpuscles.

[1] See Part I. of this Report, p. 91, pl. viii. fig. 2, 1882.

The individual cells are large and rounded, and have very granular protoplasm (Pl. XXXII. fig. 13, *tc'*.) Probably they correspond to the clumps of pigmented test cells found in *Atopogaster aurantiaca* (see p. 170, and Pl. XXIII. fig. 9, *p.c.*) and *Amaroucium lævigatum* (see p. 232, and Pl. XXX. fig. 15) and some other species.

The musculature of the mantle is very strong, and the individual muscle fibres are large. The mantle is very opaque.

The branchial sac is very narrow and the stigmata are feebly developed. The wall of the sac is opaque.

An additional species of the genus, *Psammaplidium pyriforme*, will be found described in Appendix B. at the end of the Report.

Genus doubtful.

The following species, on account of its condition, cannot be assigned to its genus with any certainty.

——————(*?*) *ignotus*, n. sp. (Pl. XXVIII. figs. 14, 15).

The Colony is a very long, narrow, and somewhat irregular mass probably attached by one end, the rest of the colony lying on the sea-bottom. The lower end is prolonged into a number of filamentous projections to which sand grains and stones are attached. The widest part of the colony is about half-way up, and from that point it tapers to the upper end. The edges are very irregular. The surface is uneven and rough, and the colour is a light grey, irregularly spotted with light yellow and with dark patches of sand.

The length is 48 cm., the greatest breadth is 3 cm., and the thickness varies from 1 to 2 cm.

The Ascidiozooids are of fair size, but are not very numerous. They are apparently arranged quite irregularly over the surface of the colony.

The Test is, considering its bulk, very soft and spongy. Its outer surface is quite irregular, and it is of the same consistence throughout. It is of a light grey colour, and rather opaque. The matrix is generally homogeneous, but in some places it is delicately fibrillated. It is crowded with test cells, most of which are of rounded forms and rather granular.

Locality.—Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8 F.

This is an interesting species on account of its very great size, but most unfortunately all the colonies I have seen are in such very bad condition that almost nothing can be made out in regard to the structure of the Ascidiozooids. There are two specimens in the Challenger collection, both from the Strait of Magellan, and in the British Museum

collection there is a large colony (about 3 feet in length[1]) labelled "Antarctic" which I believe belongs to the same species.

The British Museum specimen appears to be in a semi-decayed condition, the surface is irregular, and the Ascidiozooids are many of them partially ejected from the test. Both ends of the colony are frayed out, and one of them is in a matted condition and was probably the point of attachment. From the presence of sand grains adhering to the surface all along the specimen it is very probable that the colony was unable to grow erect, and simply lay along the sea-bottom.

The two specimens in the Challenger collection are even in worse condition for anatomical purposes. The whole of the surface is evidently decayed and rotten. The bodies of the Ascidiozooids are exposed, and are more or less torn and displaced, while even those which are in their natural positions are so decomposed that it is impossible to make out anything definite as to their structure. One colony, from which the above description and measurements were taken, is apparently complete (Pl. XXVIII. fig. 14, represents this colony on a reduced scale), the other is probably only a fragment. The complete colony consists of (1) a basal portion about 2 cm. in length, and frayed out into rootlets to which sand and stones are attached, (2) a region immediately above this, and measuring 3 cm. in length, where the test is solid but there are no Ascidiozooids, and (3) the rest of the colony, about 43 cm. in length, where there are Ascidiozooids scattered irregularly all over the surface (see Pl. XXVIII. fig. 14). The second specimen measures 25 cm. in its extreme length and 3 cm. in breadth. It is widest about half-way up, and tapers to about 1 cm. in breadth at the top. There is no base of attachment, and probably a good deal of the lower part of the colony is absent. Both specimens have sand grains adhering to the test at various parts of the surface (Pl. XXVIII. fig. 15); they were probably recumbent in position.

The Ascidiozooids show as small rounded yellow bodies about 2 mm. in diameter, imbedded in or partially projecting from the superficial layer of the test (Pl. XXVIII. fig. 15). There appear to be no portions of their bodies in the deeper parts of the colony, the centre being merely a mass of spongy test. The bodies of the Ascidiozooids are quite opaque, and they show no division into regions. Considering the great size of the colony, they are small. On some parts of the surface they are absent for considerable distances (3 or 4 cm.) (Pl. XXVIII. figs. 14, 15), but I believe that this is not the natural condition, but simply the result of the decomposition.

The test is of gelatinous consistence throughout, and, considering its light colour, is remarkably opaque. The test cells are large and very numerous. A microscopic examination of the Ascidiozooids in the Challenger specimens gives no results. The mantle can be made out in a semi-decayed condition, but inside that the branchial

[1] This is the largest Compound Ascidian I have met with.

sac and the intestine and the other viscera are in the form of a mass of granular débris mixed with mud, &c., evidently food matters from the alimentary canal.

The British Museum specimen, which, through the kindness of Dr. Günther, I was permitted to examine, is in better histological condition, and shows the following points in the structure of the Ascidiozooids. The mantle is well developed and is fairly muscular. The chief muscle bands run longitudinally. The branchial sphincter is strong. The endostyle is short but broad, and has an undulating course. The tentacles are all of one size and are numerous. The nerve ganglion is nearly spherical in form.

None of the Ascidiozooids examined showed either the branchial sac or the alimentary and reproductive viscera in sufficiently good condition to allow the details of their structure to be determined. A large conspicuous vas deferens is, however, present, and as it extends for a considerable distance behind the thorax, it may be inferred that a post-abdomen was present.

It is more from the general appearance of the colony and of the Ascidiozooids than from any special points in the anatomy that I place this form in the Polyclinidæ, and in the absence of further information in regard to its structure it is impossible to refer it to its proper genus.

I am inclined to think that both the Challenger specimens and the British Museum specimen were dead and decomposing colonies when they were found and put in spirit. Giard has shown that in some species of Compound Ascidians it is customary at certain seasons for the entire colony to die, and I have myself observed, both on the west coast of Scotland and also in the Chausey Archipelago, off the coast of Brittany, many colonies belonging to several species of Polyclinidæ in a dead and decaying condition. The test is usually in these cases in a soft and spongy state, with an irregular outer surface, and the Ascidiozooids are many of them partially or completely expelled from the colony, just as is the case in the Challenger specimens under consideration. It is to be hoped that some future explorers in the Southern Seas may be successful in obtaining specimens of this, probably the largest known, species of Compound Ascidian in a living condition.

Family IV. Didemnidæ.

Colony usually flat, thin, and incrusting, rarely thick and massive, never pedunculated.

Systems complicated and irregular, inconspicuous, or absent. Common cloacal apertures usually conspicuous.

Ascidiozooids rather small, divided into two regions—thorax and abdomen. Branchial aperture six-lobed, atrial plain, or provided with a languet.

Test gelatinous or cartilaginous, usually containing numerous stellate calcareous

spicules. Ectodermal processes well developed, and provided with muscle fibres.

Branchial Sac small, and not well developed. Rows of stigmata few, usually three or four.

Alimentary Canal united to thorax by a narrow neck. Stomach usually smooth walled.

Reproductive Organs placed alongside the intestinal loop. Male system consisting of a single large testis around which the first part of the vas deferens is spirally coiled.

Gemmation from the pyloric region; thorax and abdomen of the new Ascidiozooid formed from separate buds. Embryonic blastogenesis rudimentary only.

This is a clearly defined family, most of the members of which have a very characteristic appearance, which distinguishes them from all other groups of Compound Ascidians.

The colony is in most cases, like that of most of the Botryllidæ, a flat expanded crust, which may be of any shape (*Leptoclinum*), and is usually of a pure white colour. In some cases, however, the colony becomes thickened to form a large rounded mass (*Didemnum*). It is never much elongated vertically. Common cloacal apertures are usually distinctly visible, and they may be of large size, but the systems are always irregular and difficult to trace.

The Ascidiozooids seem at first sight very like those of the Distomidæ, and Milne-Edwards classed the two groups together as "Didemniens." In both cases the body consists of two regions only, the thorax and the abdomen; and in the Didemnidæ, as in many Distomidæ, these regions are separated by a very narrow neck composed of the œsophagus, the rectum, and the vas deferens, surrounded by a covering of mantle. A more minute examination of the Ascidiozooids shows, however, that in the details of structure the Distomidæ and the Didemnidæ are not really closely allied. In the latter group the branchial sac is feebly developed, and has only three or four rows of small stigmata, while in most of the Distomidæ the branchial sac is large and well developed; the mantle also is characteristic in the Didemnidæ, and it gives off ectodermal processes or vessels which leave the body of the Ascidiozooid not at the posterior end of the body, as in most other Compound Ascidians, but near the anterior end of the branchial sac, where it joins the branchial siphon, and in the neighbourhood of the posterior end of the endostyle. These vessels always contain muscle fibres continuous with those of the mantle, and appear to act, as von Drasche suggests,[1] as retractor muscles serving to change slightly the position of the Ascidiozooid in the investing mass. The vessels arising from the posterior end of the endostyle are provided with terminal knobs or bulbs.

The test or investing mass is usually gelatinous or cartilaginous, and its matrix is clear and structureless, but contains enormous quantities of spherical or stellate calcareous

[1] Die Synascidien der Bucht von Rovigno, p. 31, Wien, 1883.

spicules, which give to most of the Didemnidæ their characteristic appearance. Their presence renders the test hard, brittle, and opaque, and gives it in most cases a gleaming white appearance. Both by sight and by touch, a specimen of the Didemnidæ with calcareous spicules in the test may be readily diagnosed without further examination, while a lens or low power objective places the matter beyond all doubt by showing the numerous white stellate bodies imbedded in the test. In some few species, however, of the family (*e.g.*, *Didemnum tortuosum*, von Drasche), no spicules have been found. Whether this is permanently the case in these species, or is only at a certain time or in a certain condition of the colony, is not yet known. It is quite an exceptional circumstance amongst Didemnidæ.

Another very important characteristic of the family is found in the condition of the reproductive organs. The male system consists of a single very large testis of ovoid form placed on the right side of the intestinal loop, and having a long conspicuous vas deferens, the lower part of which commences its course by coiling spirally around the upper part of the testis for a number of turns. It then runs forward in the usual manner to join the rectum, along which it courses to the peribranchial cavity. The ovary consists merely of a few ova which are placed alongside the vas deferens. The mature ova are of very large size, and they frequently make their way into the common test surrounded by a covering of ectoderm, which they push out before them from the body-wall of the parent Ascidiozooid. How their escape from the common test to the exterior of the colony is effected is not yet known.

The alimentary canal is comparatively simple, and is of much the same relative size in all members of the family. The stomach is large, and is usually of more or less globular or ovate form. Its wall is almost invariably smooth, with no folds, ridges, or other thickenings. In a few cases, however (*e.g.*, *Leptoclinum speciosum*), slight ridges, formed of thickened epithelium, project into the interior, but they are not visible on the outside. In some cases the intestine may be divided into regions of different calibre (*Eucœlium hospitiolum*, Savigny), and sometimes the margin of the anus is provided with a pair of curiously curled horns or projections (see von Drasche, Die Synascidien, &c., p. 30, and Taf. xi. fig. 34).

The process of gemmation in the Didemnidæ is very remarkable. Each new Ascidiozooid in the colony arises as two buds which form respectively its thoracic and abdominal regions. The first of these develops from the region of the parent where the thorax and the abdomen join, while the second is formed a little farther back, on the abdomen. The two buds eventually join to form the body of the new Ascidiozooid. This method of budding was termed pyloric by Giard.[1] It has since been more fully investigated by Della Valle.[2] Embryonic budding, or blastogenesis, is not seen so

[1] Recherches sur les Synascidies, *Archives de Zool. expér.*, &c., t. i. p. 576, 1872.
[2] Nuove Contribuzioni, &c., p. 48, 1881.

well in the Didemnidæ as in the allied family Diplosomidæ, in which also pyloric gemmation is found in a very complete condition.

The family Didemnidæ contains only a small number of genera but has a considerable number of species, which are in some cases very difficult to distinguish from one another. Savigny founded the two original genera, *Didemnum* and *Eucœlium*, in 1816.[1] In his second memoir he characterises *Didemnum* as having both apertures of the Ascidiozooid superior (or anterior), the one with six regular lobes and the other irregular or simple; while he places *Eucœlium* in a distinct division, said to have both the apertures superior and simple. In his systematic arrangement, however (pp. 194, 195), he places the two genera close together, and defines them with more detail. The most important distinctions which he points out are that *Eucœlium* forms a thinner and more delicate crust than that of *Didemnum*, and that the branchial aperture in *Eucœlium* is circular and destitute of lobes, while that of *Didemnum* is surrounded by six equal lobes. He describes two species of *Didemnum*, viz., *Didemnum candidum*, and *Didemnum viscosum*, both from the Gulf of Suez; and one species of *Eucœlium*, *Eucœlium hospitiolum*, from the same locality. *Didemnum candidum* and *Eucœlium hospitiolum* are figured (*loc. cit.*, pl. xx.), and from these figures some further distinctive features of Savigny's two genera can be made out. In the external appearance the only noticeable distinction appears to be that the cloacal apertures (which Savigny regarded as being absent, but which are distinctly visible in his figure[2]) are much more obvious in *Eucœlium* than in *Didemnum*. In the minute structure there are several points of distinction. 1. The spicules in the test of *Didemnum* are almost spherical, having merely very slight projections, while those of *Eucœlium* have much larger projections so as to present more of a stellate appearance. 2. The pedicle connecting the branchial and visceral regions of the body is longer in *Didemnum* than in *Eucœlium*. 3. The stomach is on the dorsal side of the intestine in *Eucœlium*, while it is on the ventral side in *Didemnum*. 4. The rectum reaches almost to the anterior end of the branchial sac in *Eucœlium*, while in *Didemnum* it terminates about half-way forwards. 5. As Giard (see below) has pointed out, the mantle in *Eucœlium* is thin and transparent, allowing the branchial sac to show through, while in *Didemnum* it is thick and opaque. 6. *Eucœlium* has a peculiar little swelling upon the posterior part of the intestinal loop behind the stomach which is not found in *Didemnum*. These characters, however, do not apply to all the species of *Didemnum*.

Savigny's two genera, as represented by the type species which he figures, *Didemnum candidum* and *Eucœlium hospitiolum*, seem to be well characterised and sufficiently distinct from one another. Lamarck,[3] however, writing immediately after Savigny, seems to have thought otherwise, as he united the two genera under the one term *Eucœlium*.

[1] Mémoires, p. 64, and Système, pp. 194, 195. [2] *Loc. cit.*, pl. iv. fig. 4. [3] *Hist. Nat.*, &c.

Milne-Edwards,[1] in 1841, formed the genus *Leptoclinum* as an addition to Savigny's two genera, since he found that several species of Didemnidæ which he studied possessed common cloacal cavities which received the atrial apertures of the various Ascidiozooids, a character which Savigny denied to both *Didemnum* and *Eucœlium*, although he plainly figures the cloacal apertures in the case of the latter genus. The three genera recognised by Milne-Edwards, *Didemnum*, *Eucœlium*, and *Leptoclinum*, form the unistellar division of his Didemniens, the second great group of Compound Ascidians according to his scheme of classification. The genus *Lissoclinum*, founded by Verrill[2] in 1871, requires to be re-examined and fully described before it can be referred to its proper position with certainty. Two species have been placed in the genus, *Lissoclinum aureum* and *Lissoclinum tenerum*, both from the eastern coast of North America.

Giard,[3] in 1872, definitely established the family[4] Didemnidæ as a group including the three genera *Didemnum*, *Eucœlium*, and *Leptoclinum*, and distinguished by the possession of calcareous spicules in the common test from their nearest allies the Diplosomidæ. He points out that the cloacal cavities are exceedingly difficult to distinguish in preserved specimens, and that, in all probability, they were present in Savigny's specimens, although not detected by that investigator. Consequently Milne-Edwards' ground for the formation of the genus *Leptoclinum* does not really exist, since all the Didemnidæ have common cloacal cavities. But, as Giard points out, all the species of Didemnidæ examined by Milne-Edwards are characterised by their habit of forming very thin crusts, much thinner than those of *Didemnum*, and consequently the name *Leptoclinum* may still be retained for them, although the distinguishing feature of the genus is not what its founder believed it to be. Giard separates *Eucœlium* from *Didemnum* on account of the transparency of the mantle, the obtuse and often rudimentary lobes round the branchial aperture, the length of the rectum, and the swelling on the intestine, all of these being characters which are clearly shown in Savigny's excellent figures. *Eucœlium* he distinguishes, on the other hand, from *Leptoclinum* by the thickness of the common test, the presence of the swelling on the intestine, and the form of the cloacal aperture, which is slit-like (as in *Didemnum*) in place of being open and wide as it is in *Leptoclinum*.

Although Della Valle recognised the genus *Leptoclinum* in 1877,[5] and described three new species, he appears to have afterwards abandoned it, as in his later work, in 1881,[6] he divides his section Didemnidi, which is equivalent to the present family, into two genera: —*Didemnum* (or *Tridídemnum*), in which there are three rows of stigmata in the

[1] Observations sur les Ascidies Composées, &c.
[2] *Amer. Journ. Sci. and Arts*, ser. 3, vol. i. No. 6, p. 443.
[3] Recherches sur les Synascidies, *Archives d. Zool. expér.*, t. i. p. 644.
[4] He called it a "Tribe" (Tribus I.), *loc. cit.*, p. 644.
[5] Contribuzioni alla Storia Naturale delle Ascidie Composte del Golfo di Napoli, p. 45.
[6] Nuovi Contribuzioni alla Storia Naturale delle Ascidie Composte del Golfo di Napoli, p. 50.

branchial sac, and a well-developed atrial siphon is present; and *Tetradidemnum*, in which there are four rows of stigmata, and the atrial aperture is provided with a languet. This classification appears, however, to refer only to the species which Della Valle was investigating, and which seem from his descriptions and figures to be all referable to the old genus *Didemnum*. Consequently his *Tridídemnum* and *Tetradidemnum* may be regarded as subdivisions of Giard's *Didemnum*.

Von Drasche,[1] in his recent scheme of the classification of the Synascidiæ, does not recognise *Eucœlium*. His family Didemnidæ contains two genera only, which are named *Didemnum*, Giard, and *Leptoclinum*, Milne-Edwards, and he gives as a new distinguishing feature that the former possesses four rows of stigmata while the latter has only three rows.[2] In his large work on the Synascidiæ of the Gulf of Rovigno (1883), von Drasche divides the family into *Didemnum* and *Leptoclinum*, and then subdivides the latter genus into *Leptoclinum* and *Didemnoides;* he rejects the genus *Eucœlium* on the ground that the characters ascribed to it by Savigny and Giard are not sufficient to distinguish it from *Didemnum* and *Leptoclinum*.

If the various classifications referred to above are combined as far as possible, they will form the following scheme, which contains all the subdivisions of the family which have been proposed:—

Family.	Genus.	Subgenus.
Didemnidæ, . . .	*Didemnum.*	*Tridídemnum.* *Tetradidemnum.*
	Eucœlium.	
	Leptoclinum.	*Leptoclinum.* *Didemnoides.*

It is clear, however, that Della Valle's *Tetradidemnum*, with its four rows of stigmata and its atrial languet, is closely allied to von Drasche's *Didemnoides*, and cannot be retained as a subdivision of *Didemnum* if that genus is used in von Drasche's sense.

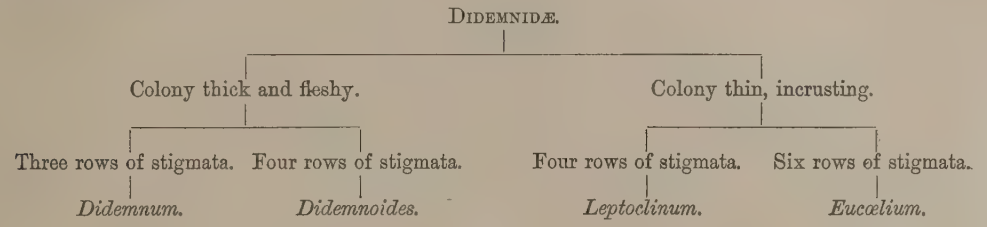
If the number of rows of stigmata is to be regarded as the most important distinguishing feature in the family, then three sections must be recognised, viz., (1) with three rows of stigmata, *Tridídemnum* (or *Didemnum* in the limited sense); (2) with four rows of stigmata, *Tetradidemnum*, *Leptoclinum*, and *Didemnoides;* (3) with six rows of stigmata, *Eucœlium* (see Savigny's figures). *Leptoclinum* and *Didemnoides* may then be separated by the thickness of the colony, leaving *Tetradidemnum* (in regard to which we have not yet sufficient information) with three possibilities before it, viz., (1) it may possibly form thin incrusting colonies, and in that case it should be included in *Leptoclinum*, (2) it may form thick masses and would then be identical with

[1] *Zool. Anzeiger*, 1882, p. 695.

[2] I am inclined to think that he has accidentally misplaced the figures and means the reverse, viz., *Didemnum*, 3, and *Leptoclinum*, 4. See also, Die Synascidien der Bucht von Rovigno, p. 9.

Didemnoides, which would therefore lapse as Della Valle's name has the priority, (3) it may have some peculiarities of its own distinguishing it from both *Leptoclinum* and *Didemnoides*, and necessitating the employment of all three sections. Della Valle's figures and remarks[1] do not decide the matter, and therefore *Tetradidemnum gigas*, Della Valle, must be provisionally placed on one side until more is known in regard to its structure and affinities.

I am not, however, inclined to ascribe very much importance to the number of rows of stigmata, since species differ in that respect which appear to be otherwise closely allied, and I have found in one new species of *Leptoclinum* (see below) three rows and four rows of stigmata present in different Ascidiozooids of the same colony. Consequently, I only use the number of rows as a diagnostic feature in conjunction with other characters, and I regard *Didemnoides* as being quite as closely related to the thick fleshy species of *Didemnum*, although it has four rows of stigmata, as it is to the thin incrusting species of *Leptoclinum*. I therefore divide the family into genera according to the following Table :—



Further remarks as to the affinities of the groups will be found under the generic descriptions.

The species of the Didemnidæ have been described chiefly by Savigny, Milne-Edwards, Giard, Della Valle, and von Drasche. The majority of them belong to the genus *Leptoclinum*, which has a wide distribution, mainly in shallow water.

In the Challenger collection only the two commoner genera *Didemnum* and *Leptoclinum* are with certainty represented, and the majority of the species belong to *Leptoclinum*. The genus *Didemnoides* contains two species found by von Drasche in the Adriatic and on the coast of Normandy. Possibly *Leptoclinum carpenteri*, *Leptoclinum japonicum*, *Leptoclinum jacksoni*, and *Leptoclinum rubicundum*, might be referred to this genus instead of to *Leptoclinum*.

In regard to *Eucœlium*, the only undoubted member of the genus that I know of is Savigny's *Eucœlium hospitiolum*, which differs markedly from all other species of the family in having six rows of stigmata in the branchial sac. Giard's *Eucœlium parasiticum* is probably, as von Drasche supposes, merely a species of *Leptoclinum*. It has only four rows of stigmata in the branchial sac.

[1] Nuove Contribuzioni, &c., p. 50.

Didemnum, Savigny.

Didemnum, Savigny, Mémoires, 1816. In part.
Didemnum, Giard, Recherches, &c., Archives d. Zool. expér., t. i. p. 647, 1872.
Tridídemnum, Della Valle, Nuovi Contribuzione, &c., 1881.
Didemnum, von Drasche, Die Synascidien, &c., 1883.
non *Didemnium*, Kowalevsky, Archiv f. mikrosk. Anat., Bd. x., 1874.

Colony usually thick and fleshy, rarely thin and incrusting.
Ascidiozooids with the atrial aperture on the dorsal edge of the thorax, often placed far back. Atrial siphon lobed or simple. No atrial languet present.
Test gelatinous or cartilaginous, usually not very hard or stiff. Calcareous spicules usually present.
Branchial Sac with three rows of stigmata.

This genus, as formed by Savigny, would include all the Didemnidæ with the exception of *Eucœlium*. Giard, however, has restricted its use by employing Milne-Edwards' genus *Leptoclinum* for the thin incrusting forms and retaining *Didemnum* for the more massive species of the family. It was more fully and correctly characterised recently by von Drasche, and it is used here in the same restricted sense, except that I do not consider the number of rows of stigmata in the branchial sac of so much importance as von Drasche does.

Della Valle's generic title *Tridídemnum* seems unnecessary, and ought to lapse. Sufficient information has not yet been given in regard to his new species *Tridídemnum benda*, but, so far as can be made out from his figures, it seems to agree in all essential points with a typical *Didemnum*. If it should happen to be a species forming a thin incrusting colony, it might be convenient to split up *Didemnum* and apply Della Valle's name *Tridídemnum* to species with thin colonies and three rows of stigmata, while the thicker species would remain under *Didemnum*.

The genus *Didemnum* as used here is characterised by having thick, massive, and usually fleshy colonies in which the test is not so hard and stiff as it is in most species of *Leptoclinum*. Calcareous spicules are as a rule present, but they are not in great abundance throughout the whole test. The ordinary arrangement is that the spicules are numerous in the superficial layers of test, and are scarce or even absent in the deeper parts. In *Didemnum inarmatum*, von Drasche, *Didemnum tortuosum*, von Drasche, and *Didemnum* (?) *inerme*, Herdman (see below, p. 265) there are no spicules present in the test.

The Ascidiozooids are characterised by having the atrial aperture placed far back on the dorsal edge of the thorax in place of being at the anterior end. As a rule there is an atrial siphon, and no atrial languet is present.

I am inclined to regard the possession of only three rows of stigmata as being of less weight than the other two important characters taken together. Therefore if I had to decide upon a species forming a thick massive colony and having Ascidiozooids in which the atrial aperture was placed far back upon the dorsal edge of the thorax and had no atrial languet, I would refer it to the genus *Didemnum*, even if there were four rows of stigmata in the branchial sac.

The three new species which follow may be readily distinguished from one another even by their external appearance, as follows:—

Didemnum savignii is of a chocolate-brown colour, and has few spicules.

Didemnum aurantiacum is of an orange colour, and has many spicules.

Didemnum (*?*) *inerme* is of a light grey colour, and has no spicules.

It is a little doubtful whether the last one really belongs to this genus, but the other two are typical species of *Didemnum*.

Didemnum savignii, n. sp. (Pl. XXXIV. figs. 1–5).

The Colony is a thick incrusting mass of irregular shape. It is attached by the entire lower surface, which is somewhat concave. The edges are thick and projecting. The upper surface is rather convex; it is even, and quite smooth. The colour is dark brown.

The length is 5·5 cm., the greatest breadth is 3·5 cm., and the thickness is 5 mm.

The Ascidiozooids are of fair size, and are abundant. They are arranged in irregularly rounded systems, and their anterior ends form rounded spots of a yellowish colour on the upper surface of the colony, and generally about 0·5 mm. in diameter. Several common cloacal apertures are visible; they are large and distinct. The bodies of the Ascidiozooids are about 2 mm. in antero-posterior length, and less than 1 mm. in greatest breadth; they are divided into two regions, thorax and abdomen.

The Test is firm and cartilaginous. It is of a dark greyish-brown colour, and is moderately transparent. The matrix is clear and homogeneous. It is densely crowded with bladder cells and small test cells. A few stellate calcareous spicules are present in some places near the upper surface, but they are by no means numerous. Rounded and elongated pigment cells of a brown colour are abundant. They are placed chiefly in the upper part of the colony.

The Mantle is fairly strong and muscular. The muscle bands are mainly longitudinal, and are placed with considerable regularity.

The Branchial Sac is moderately large, and is well developed. There are three rows of large and regularly arranged stigmata on each side. The transverse vessels are provided with muscle fibres.

The Endostyle is very large and conspicuous.

The Dorsal Lamina is represented by a few large languets.

The Dorsal Tubercle has a simple circular aperture.

The Alimentary Canal is moderately large. It forms a long narrow loop. The stomach is globular and smooth walled.

The Reproductive Organs are conspicuous, especially the testis and vas deferens which are of large size in the older Ascidiozooids. They are placed on the intestinal loop. The younger Ascidiozooids only have ova.

Locality.—Doubtful; probably Station 142, December 18, 1873; lat. 35° 4′ S., long. 18° 37′ E.; depth, 150 fathoms; bottom, green sand; bottom temperature, 47° F.

One large colony of this well-marked species was found in the collection with the label "Station 142 (?)" attached to it. I have named it *Didemnum savignii* in honour of the founder of this and most of the other important genera of the Compound Ascidians.

The colony is of irregular shape (Pl. XXXIV. fig. 1), and was attached by a large area on the lower surface. The edges are, however, free and rounded. The thickness varies from 3 mm. up to nearly 1 cm.: the average is about 5 mm. The colour is a chocolate-brown with a few lighter-coloured areas, and it is marked all over by the yellowish anterior ends of the Ascidiozooids. The systems are compound and very unequal in size. The common cloacal apertures are elliptical slits from 1·5 to 3 mm. in greatest length. They are irregularly placed on the surface (Pl. XXXIV. fig. 1).

The Ascidiozooids are rather long and narrow (Pl. XXXIV. fig. 2). The thorax and abdomen are separated by a very narrow elongated constriction or neck occupied by the œsophagus and the rectum. Narrow retractor muscles spring from the Ascidiozooids and run for a considerable distance through the test.

In its thick massive colony, with conspicuous common cloacal apertures, this species resembles *Leptoclinum maculatum*, Milne-Edwards, of which I have a specimen from the Bay of Naples, measuring as much as 1 cm. in thickness. Such a thickness is unusual in the family Didemnidæ, and especially in the genus *Leptoclinum*. In colour, however, and in some other respects this species differs from *Leptoclinum maculatum*. The Ascidiozooids are placed vertically in the colony, and where the test becomes thickened they only occupy its upper layer.

The test is relatively of large amount. It is firm and moderately tough, and is of a clear dark greyish-brown colour. The bladder cells are large and very abundant, most of them are polygonal from mutual pressure. The test cells are also numerous and conspicuous (Pl. XXXIV. fig. 3). They are coarsely granular. Various shapes occur, but rounded and fusiform ones are the most abundant. The pigment cells are scattered irregularly. In some places they are very abundant and closely placed, while in others they are absent. As a general rule the upper surface of the test is more pigmented than any other part. Most of the pigment cells are rounded, but in some places, close to the surface, they become fusiform and even elongated to a considerable

extent (Pl. XXXIV. fig. 3, *p.c.*). They tend also to become arranged in rows end to end, which gives them a fibrous appearance. They are always brown, and are coarsely granular in texture.

The spicules are stellate and very regular, their rays are tapering and sharp pointed (Pl. XXXIV. fig. 4). A few spherical forms occur. The spicules never reach quite to the external surface, but are separated from it by a layer of test containing bladder cells and pigment cells. Compared with the size of the test the number of spicules present is remarkably small.

The musculature of the mantle is almost entirely longitudinal in direction. A number of rather delicate bands spring from the base of the branchial siphon and spread posteriorly over the thorax. They occasionally give off branches, which unite with neighbouring bands, but nothing like a close network is formed. On the whole these bands run parallel with one another. A few transverse and irregularly running muscles are also present. The branchial siphon is long but narrow (Pl. XXXIV. fig. 2). It is lined by a layer of very dark coloured test, which becomes thickened at the posterior end of the siphon immediately in front of the tentacles. The branchial sphincter is powerful. The aperture is distinctly six-lobed.

The stigmata in the branchial sac are numerous (Pl. XXXIV. fig. 2), and their ciliated cells are very distinct. The muscle bands running along the transverse vessels are strong (Pl. XXXIV. fig. 5, *m.f.*). The endostyle is remarkably wide (Pl. XXXIV. fig. 2, *en.*). Its extremities form thickened projections at the anterior and posterior ends of the branchial sac. The nerve-ganglion is spherical. It is situated at the base of the branchial siphon.

The alimentary canal extends for a considerable distance behind the branchial sac. The œsophagus is very long and narrow (Pl. XXXIV. fig. 2, *œ.*). Its wall is usually thrown into a series of corrugations or slight transverse folds. The stomach is large and thick walled. It is usually ellipsoidal or nearly quadrate in shape, in some cases it is pyriform, the posterior end being narrower than the anterior. Its wall shows no folds or irregular thickenings. The œsophagus and the intestine where they join the stomach are seen in longitudinal sections to project for a short distance into its interior so as to form valvular arrangements (Pl. XXXIV. fig. 2, *st.*). The intestine is long; it extends for a short distance behind the stomach, and then turns anteriorly so as to form a narrow loop. The rectum runs close alongside the œsophagus in the long narrow region of the body which unites the thorax and abdomen (Pl. XXXIV. fig. 2, *r.*). It then runs along the dorsal edge of the branchial sac, and terminates in a small anus placed about half-way down the peribranchial cavity.

The testis is large and of ellipsoidal form. The long conspicuous vas deferens commences by coiling spirally four or five times around the testis (Pl. XXXIV. fig. 2, *v.d.*). A few ova of various sizes were found in some of the smaller Ascidiozooids. Probably

the older ones—after having produced ova in their younger stage—function as males only. Two ova were found far forwards alongside the rectum in the Ascidiozooid figured (Pl. XXXIV. fig. 2, *o*.). No larvæ were discovered in the colony.

Didemnum aurantiacum, n. sp. (Pl. XXXIII. figs. 1–8).

The Colony is a large irregularly convex mass incrusting various foreign bodies. Its upper end is rounded and roughly hemispherical. The lower part is irregular. The surface is even but slightly rough. The colour is an orange-brown.

The length is 4 cm., the greatest breadth is 5 cm., and the thickness is 2·5 cm.

The Ascidiozooids are numerous but very small, and they are placed with great regularity over the surface. They are of rounded form, and the body is not distinctly divided into regions.

The Test is thick and solid. It is firm and opaque. The outer part is of a dull orange colour, while inside it is light grey and semi-transparent. The matrix is apparently structureless. The test cells are abundant and of large size. The spicules are colourless, and are numerous on the surface, but much fewer in number deeper down. They are usually of stellate form, with moderately long rays, but occasionally spherical ones, with very short blunt rays, are met with.

The Mantle is strongly muscular.

The Branchial Sac is small and of rounded form. The stigmata are minute and inconspicuous.

The Endostyle is large and of considerable width. Its course is straight.

Locality.—Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; depth, 38 fathoms; bottom, sand and shells.

A single specimen of this species was dredged in Bass' Strait, south of Australia, from a depth of 38 fathoms. It is a handsome colony, roughly of hemispherical form (Pl. XXXIII. fig. 1), and having a dull orange-brown colour, darker in some places and lighter in others.

The Ascidiozooids are placed with great regularity over the surface, where their anterior ends form minute projections from 0·5 mm. to 1 mm. apart (see Pl. XXXIII. fig. 1). There is apparently no arrangement in systems, and no common cloacal apertures are visible in the specimen. The branchial apertures, when viewed from the outer surface (Pl. XXXIII. fig. 3), are usually of an irregularly hexagonal form.

The surface layer of test is stiff and opaque, and contains abundance of spicules (see Pl. XXXIII. fig. 2). These spicules are quite colourless, and although they may aid in producing the opacity of the test, its dull yellow colour is certainly not due to their presence, but is caused by a homogeneous yellow tint in the matrix. The coloured

layer of test is merely a superficial layer or crust, in most places about 1 mm. in thickness. The remainder of the test forms a semi-transparent hyaline mass. Sections of the deeper part of the test show comparatively few spicules (see Pl. XXXIII. fig. 4), while the test cells are abundant, of large size, and vary greatly in shape. Some of them are stellate and have their angles prolonged into processes which connect them with the angles of adjacent cells. Vascular appendages containing muscle fibres are found running vertically through the deeper parts of the test; they form more or less parallel lines (see Pl. XXXIII. fig. 4, *v.ap.*).

The Ascidiozooids are short, and are more or less rounded in form. Their branchial apertures, when examined from the interior, are found to be small and rather variable in shape. Usually they are rounded or irregularly hexagonal, but they may be stellate (probably the result of contraction), and in the example figured (Pl. XXXIII. fig. 5) the aperture is distinctly triradiate, its margin having three well-marked lobes. The sphincter muscle (*sph.*) surrounding the branchial aperture is strong, and from its outer edge a number of radiating bands arise and run posteriorly over the body, forming the longitudinal muscles of the mantle.

The test immediately around the branchial aperture is in some cases free from spicules (Pl. XXXIII. fig. 5), and consequently forms a circular lighter-coloured area representing the anterior end of the Ascidiozooid; but in other specimens the spicules extend up to the edges of the aperture (Pl. XXXIII. fig. 3, *sp.*). The commonest form of spicule in the test is seen highly magnified at Plate XXXIII. figure 6, *a*. Spicules with narrower and more sharply pointed rays are also found, and more rarely spherical forms with short blunt projections occur (see Pl. XXXIII. fig. 6).

The alimentary canal forms a short open loop. The stomach is small and of rounded form. The testis is very large, and the vas deferens form a number of close spiral coils around it (Pl. XXXIII. fig. 7).

A number of fully-developed tailed larvæ were found imbedded in the common test. They are of very large size, usually larger than the Ascidiozooids, and have two distinct pigmented sense organs (see Pl. XXXIII. fig. 8).

Didemnum (*?*) *inerme*, n. sp. (Pl. XXXIV. figs. 6, 7).

The Colony is a rounded mass attached by the greater part of its lower half. The upper surface is convex and quite smooth. The colour is a dull grey.

The length is 1·2 cm., the greatest breadth is 1·5 cm., and the greatest thickness is 1·3 cm.

The Ascidiozooids are apparently small and not very numerous. They are scattered irregularly in the upper layer of the colony, and seem not to be arranged in definite systems. No common cloacal apertures are visible.

The Test is firm and cartilaginous. It is of a grey colour, and is semi-transparent. The matrix is clear and structureless. It contains minute inconspicuous test cells, and a considerable number of large bladder cells, but no calcareous spicules are present.

Locality.—Off Bermuda, shallow water.

This is a colony of compact rounded form which was dredged off Bermuda in shallow water (Pl. XXXIV. fig. 6). It is unlike any other species in the collection, and is, I think, distinct from any known species of Compound Ascidian; but unfortunately, on account of the condition of the Ascidiozooids in the single colony at my disposal, it is impossible to give a complete specific description, or even to refer the specimen to its proper genus with certainty. All the Ascidiozooids are apparently in a decomposed condition; they are found on examination to be merely rounded or elongated masses of granular débris. Probably the colony was dead and in a decaying condition when collected.

It is simply from the general appearance, and not from any structural feature, that I place this specimen in the Didemnidæ, but it is quite possible that it may really belong to the Polyclinidæ. If, however, it is correctly placed in the present family, then, on account of its massive form (Pl. XXXIV. fig. 6), there can be little doubt that its genus is *Didemnum* or *Didemnoides*. As the former is the commoner and more widely distributed genus, I have provisionally placed the species there.

The test, as is usual in Compound Ascidians, even when the Ascidiozooids are dead, is in good condition, but no spicules are present. This, although unusual in the Didemnidæ, is not an unknown condition, as von Drasche's two species, *Didemnum inarmatum* and *Didemnum tortuosum*,[1] have no spicules in the test.

The bladder cells are large and fairly numerous (Pl. XXXIV. fig. 7, *bl.*). They are of the usual ellipsoidal form, with distinct laterally placed nuclei. The test cells are of various shapes, but are all of small size (Pl. XXXIV. fig. 7, *t.c.*).

Leptoclinum, Milne-Edwards.

Leptoclinum, Milne-Edwards, Observations sur les Ascidies Composées, 1841.
Leptoclinum, Giard, Recherches sur les Synascidies, &c., Archives d. Zool. expér., t. i. p. 651, 1872.
Leptoclinum, Della Valle, Contribuzioni, &c., 1877.
Leptoclinum, von Drasche, Die Synascidien, &c., p. 33, 1883 (as a subgenus).

Colony forming a thin incrusting layer, rarely thick and massive.
Ascidiozooids with the atrial aperture on or near the anterior end of the body, and provided with a long languet.
Test very hard and firm, densely crowded with calcareous spicules.
Branchial Sac usually with four rows of stigmata.

[1] Die Synascidien der Bucht von Rovigno, p. 32, 1883.

This genus was first instituted by H. Milne-Edwards under the impression that Savigny's Didemnidæ has no common cloacal cavities, while the species which he found living on the French coast had. As all the members of the family probably agree in having more or less well-developed common cloacal cavities and apertures, Milne-Edwards' genus was really unnecessary, but it has been retained for a section of the old genus *Didemnum*, and now includes those species which form thin incrusting colonies, with a hard test stiffened by the presence of numerous calcareous spicules. In using the name in this sense von Drasche considers it as forming only a subgenus with *Didemnoides* as its companion group, but I feel convinced that *Leptoclinum* and *Didemnoides* are as distinct from one another as either is from *Didemnum*, and therefore I regard the three groups as being genera of equal rank.

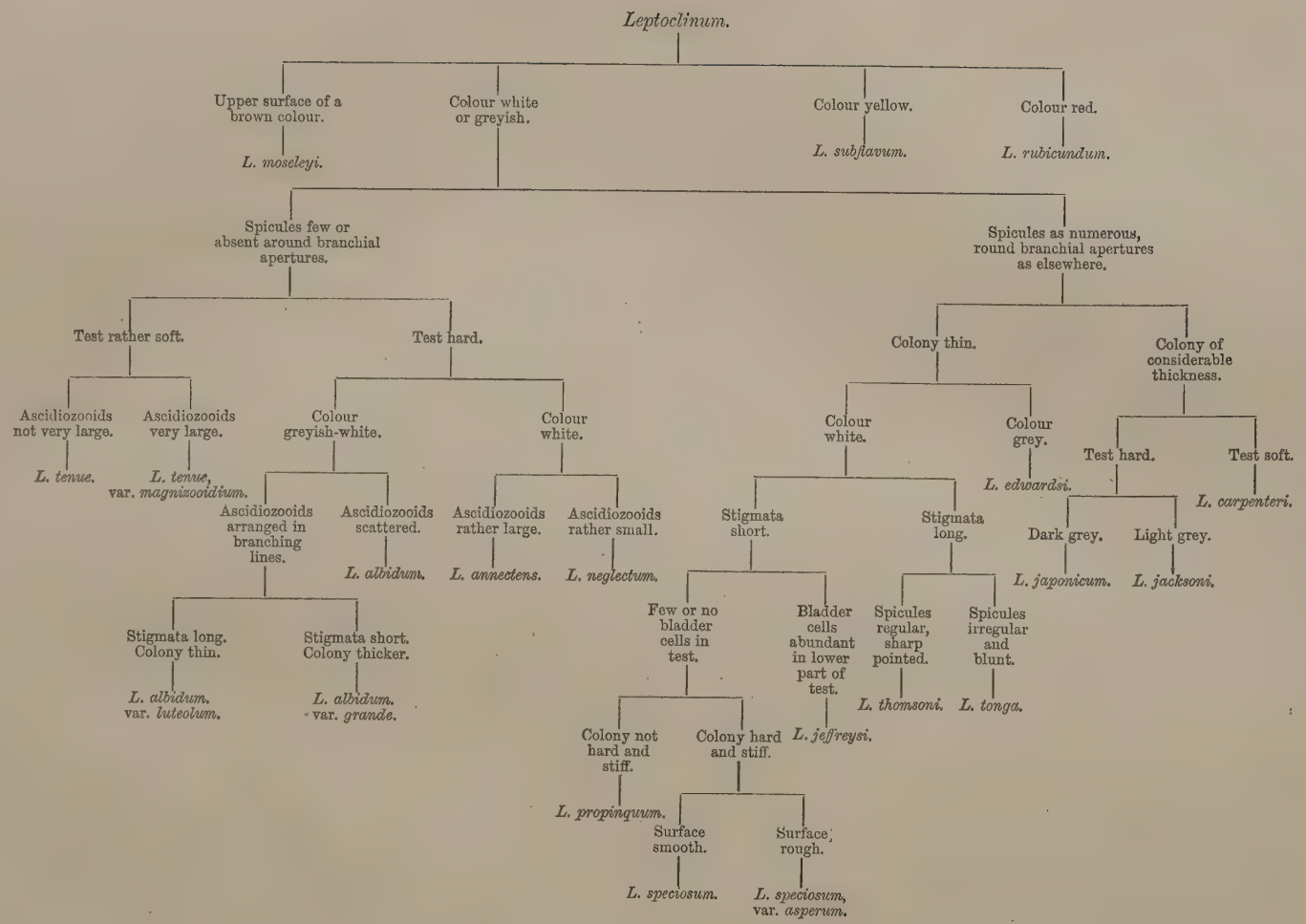
In *Leptoclinum* the Ascidiozooids have the atrial apertures placed near the anterior end of the body, and usually provided with long atrial languets. They never have simple atrial siphons like those of *Didemnum*.

The branchial sac in *Leptoclinum* has usually four rows of stigmata, but this is not an invariable characteristic, as in *Leptoclinum thomsoni* I have found that some of the Ascidiozooids in the colony have four rows, while one at least has only three, and in *Leptoclinum propinquum* there are apparently only three rows of stigmata, and yet, as I shall point out in the description of that form, I cannot regard it as being a species of *Didemnum*. On the other hand, in *Leptoclinum edwardsi* five rows of stigmata were found in one of the Ascidiozooids examined, thus showing an approach to the condition characteristic of *Eucœlium*.

The relations of the alimentary canal to the branchial sac may vary considerably in the genus. In most cases there is a distinct abdomen which extends beyond the thorax posteriorly, but in *Leptoclinum moseleyi* the alimentary canal lies on the dorsal edge of the branchial sac, and the body of the Ascidiozooid is short. This is probably a modification produced by the thin condition of the colony.

A large number of species of *Leptoclinum* have been described, chiefly by Milne-Edwards, Giard, Della Valle, and von Drasche. It is extremely difficult to distinguish some of these species, especially in the case of spirit specimens, where the natural colour is lost. I believe, however, that I am right in considering that all the Challenger specimens of this genus belong to species previously unknown to science, with the exception of those which I have referred to *Leptoclinum albidum*, Verrill, and its variety *luteolum*. It is possible that *Leptoclinum jacksoni* and two or three of the other more massive species should be removed from this genus and placed under *Diplosomoides*.

The various species and varieties of *Leptoclinum* in the collection may be distinguished shortly by the following characters :—


Leptoclinum.
Upper surface of a brown colour.
L. moseleyi.
Colour white or greyish.
Colour yellow.
L. subflavum.
Colour red.
L. rubicundum.
Spicules few or absent around branchial apertures.
Spicules as numerous, round branchial apertures as elsewhere.
Test rather soft.
Test hard.
Colony thin.
Colony of considerable thickness.
Ascidiozooids not very large.
Ascidiozooids very large.
Colour greyish-white.
Colour white.
Colour white.
Colour grey.
Test hard.
Test soft.
L. tenue.
L. tenue, var. magnizooidium.
L. edwardsi.
L. carpenteri.
Ascidiozooids arranged in branching lines.
Ascidiozooids scattered.
Ascidiozooids rather large.
Ascidiozooids rather small.
Stigmata short.
Stigmata long.
Dark grey.
Light grey.
L. albidum.
L. annectens.
L. neglectum.
L. japonicum.
L. jacksoni.
Stigmata long. Colony thin.
Stigmata short. Colony thicker.
Few or no bladder cells in test.
Bladder cells abundant in lower part of test.
Spicules regular, sharp pointed.
Spicules irregular and blunt.
L. albidum. var. luteolum.
L. albidum. var. grande.
L. thomsoni.
L. tonga.
L. jeffreysi.
Colony not hard and stiff.
Colony hard and stiff.
L. propinquum.
Surface smooth.
Surface rough.
L. speciosum.
L. speciosum, var. asperum.

Some of these forms are very closely related to one another. It should be remembered that all the specimens in the collection have been preserved in alcohol, and that some of the species, which are now all of a dull greyish-white tint, may have been distinguishable from one another by their diverse colours when living.

Leptoclinum tonga, n. sp. (Pl. XXXV. figs. 1–10).

The Colony is an irregularly shaped flat expansion, slightly thickened at the edges and attached by the greater part of the lower surface. It is of a pure white colour and is quite opaque. The upper surface is uneven but smooth.

The length is about 6 cm., the greatest breadth is about 3 cm., and the average thickness is 3 mm.

The Ascidiozooids are small and not numerous. Their anterior ends are visible as minute depressions on the surface, which are arranged in irregular branching lines. No common cloacal apertures are visible.

The Test is solid, firm, and tough. It is opaque, and of a white colour throughout. The matrix is homogeneous; it contains a few small fusiform and branched test cells and a very large number of calcareous spicules. The spicules are irregularly stellate, with the rays usually uneven and blunt at the apex.

The Mantle is moderately strong. The branchial sphincter is well developed.

The Branchial Sac is fairly large. There are four rows of long narrow stigmata.

The Endostyle is large and conspicuous. Its course is straight.

The Dorsal Lamina is represented by a series of long tapering languets.

The Tentacles are large and rather numerous. They are of two sizes, but are not arranged with perfect regularity.

Locality.—Station 172, off Tongatabu, Friendly Islands, July 22, 1874; lat. 20° 58′ S., long. 175° 9′ E.; depth, 18 fathoms; bottom, coral mud.

This is a flat incrusting species of a pure white colour. One irregularly shaped colony (Pl. XXXV. fig. 1) was obtained off the island of Tongatabu in the South Pacific, from a depth of 18 fathoms. It was evidently not attached by the whole of the lower surface, as the edges are thickened and turned upwards, forming rounded projecting margins. The lines produced on the upper surface by the branchial apertures of the Ascidiozooids form an irregular network (see Pl. XXXV. fig. 1), the meshes of which project as rounded masses of test. The edges and some other parts of the colony are formed of test only, the Ascidiozooids being by no means numerous. The thickness of the colony varies from about 1 mm. to 4 or 5 mm. The lower surface by which the colony was attached is very finely roughened, and is seen in sections to be produced into shorter and longer adhering processes of the test containing each a few spicules (see Pl. XXXV. fig. 3, *ad.*, which represents part of the lower surface cut in vertical section).

The test is large in amount relatively to the size of the colony, and it is rather hard and quite opaque. The test cells are few in number. They are seen best in the layer of test which forms the upper surface of the colony (Pl. XXXV. fig. 2, *t.m.*), and which is in most places free from spicules. The test cells are mostly fusiform, and are placed with their long axes parallel to the surface.

The spicules are very abundant, but not large. The general form is stellate (Pl. XXXV. figs. 2, 3, *sp.*), but they are characterised by their irregularity. The rays are of unequal length, and are frequently as thick near the apex as at the base, or even thicker (Pl. XXXV. fig. 4). In some cases smaller spicules with very short rounded rays, or having merely a knobbed spherical form, are seen (Pl. XXXV. fig. 4).

As this species, on account of the comparatively simple structure of the test, and the large number of very distinct spicules present, seemed to be a favourable object for an investigation into the relation between the calcareous spicules and the surrounding test matrix and the mode of formation of the spicules, I cut a large number of thin sections and examined them after various methods of treatment, with the following results :—

When a section of the test is treated, under the microscope, with a drop of hydrochloric acid, the spicules are seen to be dissolved out with effervescence, and after a short time they competely disappear, leaving a large number of rounded or polygonal vacuoles in the test (Pl. XXXV. fig. 10) which were not visible before. In many of these vacuoles distinct thickenings are seen at the angles, and in some cases the angles are produced outwards to form a rudely stellate figure (Pl. XXXV. fig. 10,—notice the vacuoles marked 1, 2, 3).

When a specimen prepared in this manner is stained with aniline blue solution a delicate membrane bounding the vacuole is brought into view by its taking on the stain more deeply than the surrounding test matrix, and the angular points, which were just visible before, now appear as distinct thickenings on this membrane (see Pl. XXXV. fig. 5).

When a small piece of the test is teased (before decalcification) so as to release some of the spicules, and these are then stained in aniline blue, in some cases a delicate membrane enclosing the spicule can be made out. It is seen best where it stretches across from one ray of the spicule to the adjacent one, as it sometimes does without dipping completely into the angle between (see Pl. XXXV. figs. 8, 9).

When a section of the test is treated with very dilute hydrochloric acid, which is washed off when the spicules are only partially solved, and is then stained in aniline blue or in eosine, spicules in all stages of solution are found, and they are seen to lie each in one of the rounded or polygonal vacuoles which have made their appearance, and the outlines of which are distinctly stained, and it is also now seen that the thickened angles of the vacuoles correspond to the apices of the rays of the contained spicules (see Pl. XXXV. fig. 7, 1 and 2).

If a thin section is soaked for from six to twenty-four hours in water saturated with carbon dioxide, it is found that the spicules are either entirely dissolved out or only partially so, according to the length of the treatment. Their remains when visible are always found inside the large spherical or polygonal vacuoles, the boundaries of which stain readily with eosine or aniline blue, and more faintly with picrocarmine. In a few cases after the treatment with carbon dioxide the vacuole was distinctly stellate in form, and not very far outside the rays of the partially dissolved spicule.

The chief difference between the sections decalcified by means of carbon dioxide and those treated with hydrochloric acid was that in the former, in nearly all cases, the more or less stellate membrane which had apparently been attached to the spicule, and was set free by its dissolution, lay distinctly inside the margin of the vacuole (see Pl. XXXV. fig. 6, where 1 shows the margin of the vacuole, and 2 the stellate membrane inside which the spicule lay).

These results seem to indicate that the calcareous spicule is formed by a group of modified test cells, which constitute, when the spicule has attained a fair size, its membranous investment.[1] Possibly the angular thickenings, which stain more deeply than the rest (see Pl. XXXV. fig. 5), may be the nuclei or the protoplasmic remains of the constituent cells. This membrane is apparently in the natural condition in close contact with the test matrix externally, and with the spicule internally, with the exception of occasional small chinks at the bases of the rays in some specimens (Pl. XXXV. figs. 8, 9). Slow decalcification with carbon dioxide sets it free from both test matrix and spicule (Pl. XXXV. fig. 6), while the more rapid action of hydrochloric acid causes the membrane to assume a polygonal or spherical form, and seems to press it outwards against the bounding test matrix (Pl. XXXV. figs. 5, 7, 10), probably as a result of the evolution of carbon dioxide. It is not, however, evident to me why, after treatment with water saturated with carbon dioxide, the vacuole in the test matrix should assume a more or less spherical form (Pl. XXXV. fig. 6), as in this case no gas is evolved.

The branchial sphincter and the muscular system generally are well developed. The invaginated test lining the branchial siphon is distinctly visible in the vertical sections (see Pl. XXXV. fig. 2, *br.*) and contains a number of calcareous spicules. A few longitudinal muscle bands start from the posterior end of the branchial sphincter and radiate outwards over the anterior part of the body.

The stigmata in the branchial sac are notable for their considerable length. The ciliated cells are distinct, and are pointed at the free ends. The tentacles are very distinctly of two sizes (Pl. XXXV. fig. 2, *tn.* and *tn'.*), which as a general rule are placed alternately.

[1] The observations which were made on the test and the discoid spicules of the genus *Cystodytes* point to a similar process of formation (see p. 139).

Leptoclinum moseleyi, n. sp. (Pl. XXXVII. figs. 9–14).

The Colony is a flat incrusting expansion of irregular shape. It is attached by a considerable portion of the lower surface, but the edges are free, slightly projecting, and corrugated in places. The colour is white on the lower surface, and brownish on the upper. The surface is even and moderately smooth.

The length is 5·3 cm., the greatest breadth is about 2 cm., and the thickness is 1 to 2 mm.

The Ascidiozooids are fairly numerous, and are of moderate size. They are distributed evenly over the upper surface of the colony, and no common cloacal apertures are visible. The bodies of the Ascidiozooids are placed mainly at right angles to the surface, and are divided distinctly into two regions, thorax and abdomen.

The Test is not large in amount, but is exceedingly hard and stiff. It consists of a clear homogeneous matrix, in which are imbedded a few small test cells and a very large number of calcareous spicules. The test matrix in the lower part of the colony is almost entirely occupied by the spicules, and in that region no test cells are visible. The spicules are mostly stellate in form, and are of fairly large size. The size and shape of the rays vary considerably in different spicules.

The Mantle is moderately thick and muscular. The branchial sphincter is particularly strong. The retractor muscles are well developed.

The Branchial Sac is very large. It has four rows of well developed stigmata arranged with regularity.

The Dorsal Lamina is represented by a series of very large triangular languets.

The Tentacles are of two sizes, the larger of which is rather long. They are placed alternately.

The Alimentary Canal is relatively of small size. It lies on the dorsal side of the posterior end of the thorax.

Locality.—Samboangan, Philippine Islands; depth, 10 fathoms.

One colony of this very remarkable species was obtained off Samboangan in the Philippine Islands, from shallow water. It is probably the most thoroughly calcareous species that is known.

The colony forms an elongated expansion of irregular form (see Pl. XXXVII. fig. 9), attached by the greater part of the lower surface, and having the edges free and projecting. The upper surface is rather depressed in the centre, and some of the corrugations of the margin curl slightly over it. The lower surface is flat, and is of a dull white colour. The upper surface varies in colour from white to dark brown (Pl. XXXVII. fig. 9). The greater part of it is of a yellowish-brown or fawn colour. The rounded edges are always white.

The Ascidiozooids are visible all over the upper surface of the colony, except on the projecting margin. Their branchial apertures form minute depressions which show as dark dots (Pl. XXXVII. fig. 9). The thorax is very much larger than the abdomen, and is placed vertically in the colony (Pl. XXXVII. fig. 10). It usually extends about three-fourths of the way across from the upper to the lower surface. The abdomen does not extend behind the thorax, but lies at right angles to it on the dorsal edge (see Pl. XXXVII. fig. 10). This condition of parts is not at all related to that found in the family Botryllidæ, where the abdomen is also placed alongside the thorax in place of extending behind it. In the present species, and some other Didemnidæ, the abnormal position of the abdomen has probably been produced by the thinness of the colony, which must have been derived from a much thicker mass, and then became gradually converted into an incrusting film. As the colony became thinner and thinner, the Ascidiozooid would gradually come to have the abdomen bent at a greater and greater angle to the original antero-posterior axis of the body, until it reached the extreme condition found in the present species, where it does not extend beyond the posterior end of the thorax, but runs outwards at right angles to it. Any further bending after this angle had been reached would be of no advantage.

In the Botryllidæ, the alimentary canal lies on one side of the body, not on the dorsal edge, and is, moreover, placed close alongside the branchial sac, so as to be covered by the same layer of mantle. In the present species, on the other hand, the alimentary canal is widely separated from the thorax, not only by the mantle, but also by a large projection of the common test which lies in the angle between the œsophagus and the posterior end of the dorsal edge of the branchial sac (Pl. XXXVII. fig. 10).

The test is so hard and brittle that it feels like a layer of solid calcareous matter. Sections show that it is very full of spicules, which are specially abundant on the lower surface of the colony (Pl. XXXVII. fig. 10, *l.s.*), and form a very dense band in which no test matrix is visible. The spicules are more closely placed in this region of the colony than in any other Leptoclinid which I have examined. The part of the test where the spicules are least crowded is the central layer, and they gradually become denser as either surface is approached. On the upper surface, however, they are not nearly so abundant as on the lower (Pl. XXXVII. fig. 10).

In the central layer of the colony the test cells and the individual spicules are most clearly seen (Pl. XXXVII. fig. 11). The test cells (*t.c.*) are small and are generally rounded or fusiform; a few of them have developed small vacuoles, but no true bladder cells are present. The spicules vary greatly in shape. Some are of the regular stellate form, with tapering rays and sharp apices (Pl. XXXVII. fig. 11, *sp'*), while others have the rays thicker and blunter. In many cases the rays are reduced to rounded knobs (Pl. XXXVII. fig. 11, *sp.*), so that the spicule as a whole may become a mammilated sphere. A few of the spicules are asymmetrical, and have one half of the surface

provided with tapering rays, while the other half has rounded knobs (see Pl. XXXVII. fig. 11, *sp″*). As a general rule the spicules close to the surfaces of the colony are sharper, while those in the deeper parts are blunter, but there are exceptions.

The branchial siphon is very large. It is lined by a thick layer of test containing spicules (Pl. XXXVII. fig. 10, *br.*, and 12, *t.* and *sp.*). The sphincter is of very large size (*sph.*). At its posterior edge on each side a strong band of muscle fibres arises which runs downwards over the thorax near its dorsal edge (Pl. XXXVII. fig. 10), and crosses the œsophagus (Pl. XXXVII. fig. 13, *m.b.*) to be inserted into the test below the abdomen, and near to the lower surface of the colony. Just after crossing the œsophagus, the muscle band is joined by a smaller bundle of fibres which arises from the mantle over the posterior extremity of the endostyle (Pl. XXXVII. fig. 13). This is in all probability, like the corresponding bands in *Leptoclinum thomsoni*, and those described by von Drasche in the case of *Didemnoides macroophorum*, a system of retractor muscles.

The branchial sac is particularly large (Pl. XXXVII. fig. 10). It is longer antero-posteriorly than dorso-ventrally. The three transverse vessels separating the rows of stigmata are moderately wide ; they are all of the same size, and are provided with bands of muscle fibres (Pl. XXXVII. fig. 14, *tr.*). The stigmatic cells are distinct and regular.

The endostyle is very large and conspicuous (Pl. XXXVII. fig. 10). The dorsal languets are larger than the tentacles. They extend nearly to the endostyle across the branchial sac (Pl. XXXVII. fig. 10). Their bases are united by a band of muscle fibres which runs along the median dorsal line of the thorax. The tentacles are fairly numerous (Pl. XXXVII. fig. 10). The smaller ones are liable to a certain amount of variation in number and arrangement.

The œsophagus runs dorsally from the posterior end of the dorsal edge of the branchial sac. It varies somewhat in calibre (Pl. XXXVII. fig. 10). The stomach lies in the same straight line with the thorax, and is elongated dorso-ventrally. It is not large, and its walls show no ridges nor other thickenings. They are lined by long columnar cells (Pl. XXXVII. fig. 10). No reproductive organs were found in any of the Ascidiozooids examined.

Leptoclinum speciosum, n. sp. (Pl. XXXVI. figs. 1–8).

The Colony is a flat expanded mass of considerable size. It is thin and incrusting, and is attached by the whole of the lower surface. The upper surface is even, and perfectly smooth. The colour is pure snow white.

The length is about 5 cm., the breadth is 4·5 cm., and the general thickness is about 2 mm.

The Ascidiozooids are numerous and of fair size. They are closely placed all over the upper surface of the colony. They are not arranged in definite systems, but common

cloacal apertures of small size, and surrounded by six lobes, occur frequently over the surface of the colony. The bodies of the Ascidiozooids are placed vertically in the colony, and are distinctly divided into two regions, thorax and abdomen.

The Test is hard and brittle. It is white, and is opaque throughout. The matrix is structureless, and contains large numbers of calcareous spicules and of test cells. The latter are mostly fusiform, or triangular in shape. The spicules are stellate or spherical. They vary somewhat in size and shape. Vessels with swollen ends also occur in the test; they are not numerous, but they occasionally branch near their terminations.

The Mantle is thin and membranous. The musculature is feeble.

The Branchial Sac is small, but the stigmata are well developed. There are four rows, separated by wide tranverse vessels. The stigmata are short but regular.

The Endostyle is large and conspicuous.

The Alimentary Canal is of considerable size. It forms a narrow loop placed behind the branchial sac.

The Reproductive Organs are placed alongside the intestine. The testis is large, and the vas deferens is spirally coiled around it.

Locality.—Bahia, Brazil, September, 1873; depth, 7 to 20 fathoms.

One large colony and several smaller ones of this handsome species were obtained in shallow water off Bahia, on the east coast of South America. They incrust Sponges (Pl. XXXVI. fig. 1) and other foreign bodies.

In most cases the colony is a thin expansion attached throughout its entire extent, but in some of the smaller colonies some parts become thickened and form projecting lobes (Pl. XXXVI. fig. 3 shows a section through such a thickened knob). The surface is always smooth and of a pure opaque white colour. The dimensions given above are those of the large colony. The other specimens in the collection are all considerably smaller.

The Ascidozooids are distributed evenly over the surface of the colony, and their anterior ends show distinctly as small circular dots (Pl. XXXVI. fig. 1). The common cloacal apertures are numerous but of very small size. Slight magnification with a lens allows the lobes surrounding both the branchial and the common cloacal apertures to be distinctly seen (Pl. XXXVI. fig. 2, *br.* and *at.*). In both cases there are six, and they are triangular in form, consequently the closed apertures have a stellate appearance.

The abdomen of the Ascidizooid lies nearly directly behind the thorax, and is about equal to it in size (Pl. XXXVI. fig. 3). It extends from one-half to three-fourths of the way from the upper to the lower surface of the colony, except in places where the test is especially thick (Pl. XXXVI. figs. 8 and 3). In such cases the thickening is in the test below the posterior ends of the Ascidiozooids.

The test is not tough. It is hard and white all though, but the spicules are more abundant near the upper surface than elsewhere (Pl. XXXVI. figs. 3, 8). A section through the test in the middle of the colony shows (Pl. XXXVI. fig. 4) the homogeneous matrix, the test cells, the spicules, and the ectodermal vascular appendages of the Ascidiozooids. The ectodermal appendages (or vessels) are specially noteworthy in the present species on account of their exhibiting branching (Pl. XXXVI. figs. 4, 8), a feature which has not been previously noticed, I think, in any of the Leptoclinidæ. The terminations of the vessels are swollen to form ovate bulbs covered with thickened epithelium (Pl. XXXVI. fig. 4, *t. k.*). A few muscle fibres are found in some of the vessels, but the musculature is not so well developed as in some other species of the Leptoclinidæ. A few small bladder cells are found in this test (Pl. XXXVI. fig. 4, *bl.*), but they are inconspicuous, and in most cases are not so large as the spicules. The ordinary test cells are rather large. Near the surfaces they are elongated in form and lie with the long axis parallel to the surface. The spicules vary considerably in shape. Some, and they are generally the smaller ones, are simple spheres, others are spherical with mammillated or knobbed surfaces (Pl. XXXVI. fig. 4, *sp.*), while the larger spicules are stellate with spherical centres and a number of projecting rays with, in most cases, sharp apices. The spicules are generally very regular, but a few deformed or monstrous forms may be seen.

The branchial siphon is large (Pl. XXXVI. figs. 3, 8, *br.*) and its sphincter is very well developed, but over the mantle generally the musculature is feeble (Pl. XXXVI. fig. 6, *m.b.*). The ectoderm on its outer surface is in some places very distinct, the outlines of the polygonal cells and their central nuclei being clearly visible (Pl. XXXVI. fig. 5). The branchial siphon has a thick lining of test in which spicules are present (Pl. XXXVI. fig. 8, *br.*).

The branchial sac is longer antero-posteriorly than dorso-ventrally. It is of ovate form (Pl. XXXVI. fig. 3). The transverse vessels are wide, and are all of the same size (Pl. XXXVI. fig. 8).

The œsophagus runs directly backwards from the posterior end of the branchial sac to open into the large ovate stomach which is placed with its long axis antero-posteriorly.

The wall of the stomach shows no ridges externally, but is produced internally into four longitudinal pads so as to reduce the lumen to an × -shaped slit (see Pl. XXXVI. fig. 8, left side of figure). Where the œsophagus and the intestine join the stomach at its anterior and posterior ends these tubes are produced inwards for short distances so as to form valvular arrangements (Pl. XXXVI. fig. 8). The intestine is narrow. It runs posteriorly for a short distance from the stomach, and then turns forwards so as to run alongside the stomach and œsophagus, forming a short loop. Various parts of its course are seen in the sections represented in figures 3 and 8.

The large ovate testis lies alongside the intestinal loop, and the vas deferens

commences by coiling six or seven times around it (Pl. XXXVI. fig. 8, *t.v.*). Figure 7 on Plate XXXVI. shows a section through the testis (*t.v.*) with some of the coils of the vas deferens (*v.d.*) on its surface. No ova and no embryos nor larvæ were found in any of the Ascidiozooids examined.

Leptoclinum speciosum var. *asperum*, nov. (Pl. XXXIV. figs. 8–13, and Pl. XXXVI. fig. 9).

The Colony is a thin incrusting layer of irregular shape, attached by its whole extent. The upper surface is somewhat uneven, and it is rough all over. The colour is white.

The length is about 5 cm., the breadth about 3 cm., and the thickness from 1 to 2 mm.

The Ascidiozooids are numerous and fairly large. They are closely placed all over the surface of the colony. Some cloacal apertures are present here and there, but no definite systems are visible. The Ascidiozooids are elongated antero-posteriorly, and are placed vertically in the colony. The thorax and abdomen are distinctly separated.

The Test is hard and brittle. It is opaque white throughout. The matrix contains small test cells, numerous calcareous spicules, and, in the superficial layer, a few bladder cells. The spicules are stellate, of regular form, and of considerable size. Ectodermal prolongations from the Ascidiozooids are also met with in the test.

The Mantle is moderately thick and muscular, the branchial sphincter is powerful, and retractor muscles are present.

The Branchial Sac is small. There are four rows of short stigmata, and the transverse vessels between them are wide.

The Endostyle is wide and conspicuous. It undulates greatly from side to side in its course.

The Dorsal Lamina is represented by a series of long narrow languets.

The Tentacles are large. They are sixteen in number, and are of two sizes, placed alternately.

The Alimentary Canal is large. It forms a long narrow loop behind the branchial sac.

Localities.—(*a.*) Bahia, Brazil, September 1873; depth, 7 to 20 fathoms. (*b.*) Station 142, December 18, 1873; lat. 35° 4′ S., long. 18° 37′ E.; depth, 150 fathoms; bottom, green sand; bottom temperature 47° F.

Several colonies obtained in shallow water off Bahia, on the east coast of South America, form a very distinct variety. In external appearance they differ markedly from the typical forms of the species, found in the same locality, in having the surface finely roughened all over in place of being smooth. As the internal structure also differs somewhat in the two forms, it is doubtful whether it might not be better to

regard them as distinct species. The specimens from Station 142 are, however, intermediate in some of their characters.

The shape of the colony varies with that of the object to which it is attached. The largest colony (the dimensions of which are given above) has grown over the surface of a Sponge and some other objects, and its form is most irregular (Pl. XXXIV. fig. 8); while some of the smaller colonies are attached to the branches of a Plumularian Zoophyte, around which they have grown in such a way as to form nearly regular cylinders (Pl. XXXVI. fig. 9). One of the smaller colonies on the Zoophyte is, however, quite irregular in form (Pl. XXXVI. fig. 9, left side of figure). The colour is not quite such a pure white as in the case of *Leptoclinum speciosum*, but this is probably the result of the roughness of the surface.

In number, size, distribution, and position in the test, the Ascidiozooids resemble those of the typical specimens of *Leptoclinum speciosum*. The common cloacal apertures are also similar to those of that species, but are not quite so numerous. As in *Leptoclinum speciosum*, both the branchial apertures and the common cloacal apertures are surrounded by six triangular lobes.

The bodies of the Ascidiozooids are considerably elongated antero-posteriorly (Pl. XXXIV. fig. 9), and the abdomen is longer than the thorax. The posterior end of the Ascidiozooid does not reach to the lower surface of the colony.

As in the case of *Leptoclinum speciosum* the spicules in the test are more abundant near the upper surface than elsewhere. They are, however, fairly numerous in all parts. A vertical section through the colony (Pl. XXXIV. fig. 9) shows that the cause of the roughness on the upper surface is the presence of a number of short spine-like projections from the surface of the test. These are formed of test matrix containing numbers of sharply pointed spicules which are developed close up to the surface of the test (see Pl. XXXIV. figs. 9, 10). In the spaces between these pointed projections, the surface layer of test is for a short distance generally free from spicules, and is on the other hand occupied by large bladder cells (Pl. XXXIV. fig. 10, *bl.*). The bladder cells are, as a rule, only one row deep, and are placed closely side by side. They are polygonal or ellipsoidal in shape from mutual pressure, and are usually elongated at right angles to the surface of the colony. The test cells are small and not very abundant; they are mostly of rounded or fusiform shapes (Pl. XXXIV. fig. 10). The matrix shows in some places a delicate fibrillation.

The spicules are more than usually regular (Pl. XXXIV. fig. 10, *sp.*). The rays are long and pointed, and spherical or mammillated forms are very rarely met with. In an optical section, through the centre, the spicule has the appearance shown in figure 11, where each ray is seen to be continued into the centre of the spicule in the form of a short wedge. There is a tendency for the spicule to break up along the lines separating the wedges, so as to produce pieces having the form shown in figure 12. Consequently

the spicule seems to be built up of a number of short wedges or cones joined by their apices, and having the bases prolonged into tapering rays.[1]

The muscle bands in the mantle are delicate but very numerous. They run longitudinally, transversely, and irregularly, and form a close network over the thorax. The branchial siphon is very large, in some cases nearly as large as the branchial sac. It is lined by test containing a number of spicules (Pl. XXXIV. fig. 9, *br.*). The branchial sphincter is large, and it gives rise at its posterior edge to a strong retractor muscle on each side, which runs backwards over the thorax near the dorsal edge, and, after joining a smaller muscle band from the mantle in the neighbourhood of the posterior extremity of the endostyle, runs outwards into the test for a considerable distance. This retractor muscle is, when in the test, a tubular prolongation of the mantle; it may be regarded as a vascular appendage from the Ascidiozooid, in the walls of which muscle fibres have been developed.

The branchial sac is a small ovate organ (Pl. XXXIV. fig. 9) with rather thick walls and small stigmata. The endostyle is especially large. The dorsal languets are long, and are tentacular in shape; there is one on each transverse vessel. The tentacles are rather larger than is usual in the Didemnidæ (see Pl. XXXIV. fig. 13). There are eight larger and eight smaller placed alternately.

The œsophagus leads directly backwards from the posterior end of the small branchial sac to the rather large stomach (Pl. XXXIV. fig. 9). The shape of the stomach is ellipsoidal, and its outer wall is smooth. Several longitudinal thickenings formed of long columnar cells project into the lumen. The intestine is very similar in appearance and course to that of *Leptoclinum speciosum.*

The testis is large, and lies alongside the intestinal loop. The vas deferens is conspicuous; it commences by coiling from eight to ten times spirally around the testis (Pl. XXXIV. fig. 9).

Two small cylindrical colonies of this species were obtained at Station 142 near the Cape of Good Hope, from a depth of 150 fathoms. They are exactly like the elongated forms of *Leptoclinum speciosum*, var. *asperum* from Bahia (figured in Pl. XXXVI. fig. 9), in all respects except that the surface is perfectly smooth. The Ascidiozooids seem, however, to be rather more numerous and more closely placed than in *Leptoclinum speciosum.* The spicules vary a good deal in size, but resemble those of that species and its variety. These specimens from Station 142 seem to be in an intermediate condition between *Leptoclinum speciosum* and the variety *asperum*, and show therefore that the two forms cannot be regarded as distinct species.

[1] In this respect they resemble the spicules of some Alcyonaria, such as *Sarcodictyon* and *Alcyonium.* The simple spicules, formed of 1, 2, 3, or 4 pieces only, found in *Sarcodictyon* (see Herdman, On the Structure of Sarcodictyon, *Proc. Roy. Phys. Soc. Edin.*, vol. viii. p. 31, 1884) never seem to occur in the Leptoclinids.

Leptoclinum annectens, n. sp. (Pl. XXXIV. fig. 14, and Pl. XXXVIII. figs. 5–9).

The Colony is an irregularly rounded but thin and incrusting mass, which is attached by the greater part of the lower surface. The upper surface is uneven but fairly smooth. The colour is white.

The length is 3·5 cm., the breadth is 2 cm., and the thickness is 2 mm.

The Ascidiozooids are numerous and rather large. They are conspicuous on the outside of the colony. They are distributed evenly over the surface, and do not form definite systems. The branchial apertures are very distinct. A few common cloacal apertures are present. The bodies of the Ascidiozooids are distinctly divided into thorax and abdomen.

The Test is not very hard, and it is not stiff. It is opaque white throughout. The test cells are small and inconspicuous, and stellate calcareous spicules are abundant, especially near the upper surface. There are no bladder cells.

The Mantle is thin, and the musculature is feebly developed. The branchial siphon is short, and the sphincter muscle is not strong.

The Branchial Sac is well developed. The stigmata are large and regularly arranged. There are four rows, with six or seven stigmata in each row. The transverse vessels are very narrow, but have delicate muscle bands.

The Endostyle is narrow. Its course is straight.

The Dorsal Lamina is represented by a series of languets.

The Tentacles are long and narrow. There are sixteen of them; they are of two sizes and are placed alternately.

The Alimentary Canal is rather small. The stomach is globular and of small size.

Locality.—Off Bahia, Brazil, September, 1873; shallow water.

One colony of this species was obtained in shallow water off Bahia, on the east coast of South America. In external appearance it is not unlike *Leptoclium speciosum*, but differs in being not quite so white and smooth, and in having the Ascidiozooids more numerous and more closely placed. It resembles *Leptoclinum tenue* in some respects, but is much thicker and more solid and has the Ascidiozooids relatively smaller, while the spicules are, as a rule, larger.

The edges of the colony were not attached, but form free rounded projections. The Ascidizooids, which are very distinctly seen on the rest of the colony (Pl. XXXIV. fig. 14), do not extend quite up to the margin. Under a slight magnification with a lens the branchial apertures, which are just visible to the eye, can be seen clearly (Pl. XXXVIII. fig. 5, *br.*). They are each surrounded by six triangular lobes which give the aperture a stellate appearance when not widely open (Pl. XXXVIII. fig. 6). The common cloacal apertures are small. They are also stellate, but are not so distinctly six-lobed as the branchial apertures (Pl. XXXVIII. fig. 5, *cl.*).

The spicules in the test are much more numerous in the upper layer than in the deeper parts, and they are most abundant between the anterior ends of the bodies of the Ascidiozooids. Consequently in surface view under a low power the Ascidiozooids show through as closely placed elliptical areas of a lighter colour separated by bands of opaque test densely crowded with spicules. The edges of the lobes around the branchial apertures are strengthened with a line of spicules, and there is generally a little group which forms a thickening at the apex of each lobe.

The branchial sac is wide, but not long. The stigmata are particularly large and well developed (Pl. XXXVIII. fig. 8, *sg.*). The transverse vessels vary somewhat in calibre, but they are never very large. In some places they are exceedingly narrow, and the pointed ends of the stigmata in adjacent rows almost meet (Pl. XXXVIII. fig. 8, *tr.*). The ciliated cells are rather small; their free ends do not project.

The endostyle, though conspicuous, is not so wide as usual (Pl. XXXVIII. fig. 9, *en.*), and has not the undulating course so common in Compound Ascidians. The dorsal languets are narrow. The tentacles are very delicate, but the larger ones are rather long (Pl. XXXVIII. fig. 9, *tn.*). There are usually eight long and eight short. The nerve ganglion is ellipsoidal in form. The aperture of the dorsal tubercle is circular (Pl. XXXVIII. fig. 7, *d.t.*). It opens just posterior to the peripharyngeal band, and leads at once into a short wide infundibulum.

The œsophagus runs posteriorly from the branchial sac to open into the globular smooth-walled stomach. The intestine is long and forms a widish loop. It presents a small dilatation on its course just at its most posterior part.

Leptoclinum tenue, n. sp. (Pl. XXXIX. figs. 8–11, and Pl. XL. figs. 3–5).

The Colony is a small, more or less rounded, incrusting patch. It is thin, and is attached by the entire extent. The upper surface is fairly smooth. The colour is pure white.

The length is about 1·5 cm. and the breadth about 1 cm.; the thickness is very slight, 0·25 to 0·75 mm.

The Ascidiozooids are large and fairly numerous. They are closely and regularly placed all over the surface of the colony. Common cloacal apertures are not visible. The bodies of the Ascidiozooids are very short.

The Test is moderately firm, but tears easily. It is of an opaque white colour throughout. The structureless matrix contains minute rounded test cells and numerous calcareous spicules. There are no bladder cells. The spicules are mostly stellate and regular, but a few are nearly spherical or of irregular form.

The Mantle is rather muscular.

The Branchial Sac is small.

The Tentacles are few and short.

Locality.—(*a*) Station 308, January 5, 1876; lat. 50° 8′ 30″ S., long. 74° 41′ 0″ W.; depth, 175 fathoms; bottom, blue mud. (*b*) Station 311, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ 0″ W.; depth, 245 fathoms; bottom, blue mud; bottom temperature, 46° F. (*c*) Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2 F. (*d*) Station 12 of "Lightning" expedition in 1868; lat. 59° 36′ N., long. 7° 20′ W.; depth, 530 fathoms; bottom, "Atlantic ooze"; bottom temperaure, 6°·4 C. (= 43°·5 F.).

Under this species I have united a number of specimens which resemble one another more or less closely.

About two dozen small specimens were obtained at Station 308, off the west coast of Patagonia, from a depth of 175 fathoms. The dimensions given in the above description are taken from one of the largest colonies, the smaller ones are only a couple of millimetres across. About twenty specimens were obtained at Station 311, at the western end of the Strait of Magellan, from a depth of 245 fathoms. Most of these are also small, but one or two extend to a larger size (2 to 2·5 cm. in length) than that of the specimens from Station 308. One large colony was obtained at Station 320, off the east coast of Patagonia, from a depth of 600 fathoms. In some respects this specimen differs from the others, and it may possibly be a distinct variety. A few small colonies obtained on September 6, 1868, during the cruise of the "Lightning," at Station 12, in the "warm area" of the Færoe Channel, from a depth of 530 fathoms, so closely resemble the South American forms that they are practically indistinguishable. Closely related to these specimens which are placed in the species proper there is another which I have regarded as forming a distinct variety (var. *magnizooidium*, see below).

In the typical specimens of *Leptoclinum tenue* the colony is small and rounded, and forms a thin incrusting layer, generally with a rather uneven upper surface (Pl. XXXIX. fig. 8). As a rule no common cloacal apertures are visible in the preserved specimens, but in one or two colonies a single centrally placed elliptical slit was present.

The Ascidiozooids are large and conspicuous. Their anterior ends form rounded projections on the upper surface, generally of an elliptical or nearly circular shape (Pl. XXXIX. fig. 9), and measuring about 0·5 mm. in the longer diameter. The Ascidiozooids are inclined at an angle to the surface of the colony, and are short antero-posteriorly. They are not arranged in definite systems (Pl. XXXIX. fig. 9).

The test, although opaque, is thin and rather soft. Its upper layer tears off readily, leaving the Ascidiozooids adhering to the lower part of the colony. A surface view of this upper layer of test, under a low power (Pl. XXXIX. fig. 10), shows the arrangement of the spicules very clearly. They are most numerous in the test immediately around the bodies of the Ascidiozooids, where they form dark circumscribing lines; inside these

areas, which are of circular or elliptical form (Pl. XXXIX. fig. 10), the spicules are scarce, and are scattered irregularly, while outside, in the test lying between the Ascidiozooids, they are fairly abundant. The six well-marked lobes which surround the branchial apertures are strengthened and rendered conspicuous by lines of spicules which border their edges (Pl. XXXIX. fig. 10, *br.*). In the deeper layers of the test the spicules are abundant. They are scattered irregularly.

The spicules are not large, and are fairly uniform in size. They are not so large as and are less densely packed than in the case of *Leptoclinum annectens*, which the present species resembles somewhat in general appearance. The majority of the spicules are regularly stellate in form, and have rather short rays. Here and there a few mammillated spherical forms occur, and occasionally deformed or monstrous forms with long irregular rays (Pl. XXXIX. fig. 11) are found; these abnormal spicules are, however, very rare.

The branchial siphon is large. It is lined by a layer of test containing spicules. The sphincter is well developed. The branchial sac is small, and is usually crumpled, doubtless from contraction in death. The stigmata are long and narrow, and the ciliated cells are distinct.

The endostyle is wide and its course is undulating. The tentacles are short. There are eight or ten of them.

The alimentary canal is small. The stomach is globular and smooth-walled. The intestine forms a short wide loop. The testis is large, and has the vas deferens coiled spirally around it.

A few large tailed larvæ were found in the colony. They have the body nearly circular in outline, with two pigmented sense organs placed on one side, nearer the anterior than the posterior end.

There are some undescribed specimens of *Leptoclinum* in the British Museum collection which were obtained during the cruise of the "Alert," from (*a*) Tom Bay, on the south-west coast of Chili, depth 0 to 30 fathoms; and (*b*) Sandy Point, in the Strait of Magellan, which are closely allied to the present species. They differ, however, in having the spicules more numerous and of a more spherical shape, the rays being generally very short and blunt.

The "Lightning" specimens obtained in the North Atlantic, between Scotland and the Færoe Islands, are all attached to a fragment of Coral (Pl. XL. fig. 3). They are of small size and of a pure white colour, and agree well in almost all points of structure with the Challenger specimens described above. The spicules, however, seem to be more closely placed in the superficial layer of the test, and especially over the areas occupied by the Ascidiozooids. Most of the spicules are of the same size and shape as those in the other specimens of the species (Pl. XL. fig. 4), but a few very much larger forms of regularly stellate shape, and provided with many rays (Pl. XL. fig. 5), occur scattered through the test.

Leptoclinum tenue, var. *magnizooidium*, nov. (Pl. XL. figs. 1, 2).

The Colony is a flat expansion of irregular shape. It is attached by its entire extent. The upper surface is even and smooth. The colour is a dull white.

The length is about 3 cm. and the breadth about 2 cm.; the thickness is from 1 to 2 mm.

The Ascidiozooids are very large and fairly numerous. They are placed regularly over the surface, but are not arranged in definite systems. No common cloacal apertures are visible. The Ascidiozooids have short bodies, and are placed obliquely in the colony.

The Test is soft and tears easily. It is of an opaque white colour throughout. The matrix contains a comparatively small number of minute test cells and a very large number of calcareous spicules. No bladder cells are present. The spicules are large, and are of very regular stellate form.

Locality.—Unknown.

The specimen for which I institute this variety was obtained during one of the cruises of H.M.S. "Porcupine," but the exact locality is unknown. It is attached to an old worn fragment of Coral (Pl. XL. fig. 1).

The colony is of irregular form, and has a thin expanded margin. Like the specimens of *Leptoclinum tenue*, it has large distinct Ascidiozooids which make conspicuous marks on the upper surface, but it differs from them in having the edges less definite and rounded, in not being so white in colour, and in having both the Ascidiozooids and the spicules distinctly larger. The upper surface of the colony also is rather smoother in the present variety (Pl. XL. fig. 1).

The arrangement of the spicules in the upper layer of the test is essentially the same, but they are more numerous in the variety than in the typical members of the species, The areas between the Ascidiozooids are quite opaque, and over the bodies of the Ascidiozooids the spicules are fairly numerous. The edges of the six lobes round the branchial aperture are strengthened by masses of closely placed spicules.

The spicules in the variety are all of the same size, and are remarkably regular in form. They are stellate (Pl. XL. fig. 2). The rays are not very long, and are moderately sharp. No irregular or deformed spicules were noticed.

Leptoclinum propinquum, n. sp. (Pl. XXXIX. figs. 16–20).

The Colony is of irregularly rounded form, and is closely attached by its entire extent. The upper surface is smooth. The colour is a greyish-white.

The length is about 2 cm. and the breadth 1 cm., the thickness is 1 mm.

The Ascidiozooids are fairly large and numerous. They are very conspicuous externally, but are not arranged in definite systems. No common cloacal apertures are present. The bodies of the Ascidiozooids are short, and are divided into thorax and abdomen.

The Test is rather soft, and tears easily. It is of a greyish-white colour, and is nearly opaque. The matrix contains small test cells and numerous calcareous spicules. There are no bladder cells. The spicules vary somewhat in size. They are of rather regular stellate forms.

The Mantle is fairly muscular. The branchial sphincter is well developed.

The Branchial Sac is small. It has three rows of small but regularly arranged stigmata.

The Alimentary Canal is rather large. The stomach is globular and smooth-walled.

Locality.—Station 311, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ 0″ W.; depth, 245 fathoms; bottom, blue mud; bottom temperature, 46° F.

Several small colonies of this species are attached to a worn fragment of Coral trawled at Station 311, at the western end of the Strait of Magellan, from a depth of 245 fathoms. The dimensions given above are those of the largest colony, the others are considerably smaller. They are all incrusting forms (Pl. XXXIX. fig. 16), and resemble the specimens of *Leptoclinum tenue* closely in their external characters. The colour, however, is distinctly greyer, and the Ascidiozooids are rather larger, and are placed further apart in the present species. The arrangement of the spicules in the surface layer of test is quite different in the two cases (compare figs. 10 and 17 in Plate XXXIX.). In the present species they are uniformly distributed, except immediately around the branchial apertures, where they are more numerous. The edges of the six lobes are especially strengthened by closely placed spicules. The branchial apertures are regularly six-rayed (Pl. XXXIX. fig. 17, *br.*).

The spicules are mostly stellate, with many narrow pointed rays (Pl. XXXIX. fig. 20). Some, however, have the rays shorter and broader so as to produce a more nearly spherical form of spicule. The test cells are very inconspicuous. Most of them are small and rounded, but a few elongated and some larger branched forms occur.

The thorax and abdomen in the body of the Ascidiozooids are distinctly separated (Pl. XXXIX. fig. 18), and are of about the same size. There are two strong retractor muscles, one running backwards on each side from the branchial sphincter, along the dorsal edge of the thorax.

The transverse vessels of the branchial sac are narrow (Pl. XXXIX. fig. 19, *tr.*); they are usually of the same size as the fine longitudinal vessels. The ciliated cells bounding the stigmata are distinct (Pl. XXXIX. fig. 19, *sg.c.*). The endostyle is very large and conspicuous (Pl. XXXIX. fig. 18); its course is straight.

The alimentary canal forms a wide loop. The œsophagus leaves the dorsal edge of the posterior end of the branchial sac, and runs directly backwards to the large smooth-

walled stomach (Pl. XXXIX. fig. 18). The intestine leaves the posterior end of the stomach and at once turns dorsally and then anteriorly. It lies close to the œsophagus at the posterior end of the branchial sac.

The testis forms a large rounded mass placed alongside the intestine (see Pl. XXXIX. fig. 18). The vas deferens commences by coiling spirally around the testis. No ova and no embryos were discovered in the colony.

This form is one of those which make me very doubtful as to the propriety of separating the genera *Didemnum* and *Leptoclinum* by the number of rows of stigmata in the branchial sac. If that course were adopted, the present form would have to be regarded as a species of *Didemnum*, but the extreme thinness of the colony (about 1 mm.) is a strong argument against such a view. Then, again, it is so similar in some respects to the specimens of *Leptoclinum tenue* from the west coast of South America and from the North Atlantic, that for some time I hesitated to describe *Leptoclinum propinquum* as a distinct species, and cannot therefore bring myself to regard these two forms as belonging to separate genera.

Leptoclinum neglectum, n. sp. (Pl. XXXVIII. figs. 10–13),

The Colony is irregularly shaped, and incrusting. It is attached by the greater part of its lower surface. The upper surface is fairly smooth. The colour is a dull white.

The length is about 3 cm., the breadth 1·5 cm., and the thickness 2 mm.

The Ascidiozooids are numerous but rather small. They are distributed evenly over the surface of the colony, and are not arranged in definite systems. A few slit-like common cloacal apertures are visible.

The Test is moderately hard and firm. It is of a greyish-white colour in most parts, and is quite opaque. The matrix contains small rounded test cells and large numbers of calcareous spicules. No bladder cells are present. The spicules are large and of regular stellate form.

The Mantle is moderately strong, both transverse and longitudinal muscles are present.

The Branchial Sac is short and wide. The stigmata are large and regularly arranged. The ciliated cells are distinct.

The Tentacles are few and of small size.

The Alimentary Canal forms a long narrow loop.

Locality.—Unknown.

This colony, which was found in a small bottle without a label, and of which therefore the locality is unknown, is in some respects allied to *Leptoclinum annectens*, and in others resembles *Leptoclinum tenue*, but is, I consider, sufficiently distinct from both to be entitled to a separate description.

It adheres to a fragment of Sponge, round one branch of which it has grown so as to completely incrust it (Pl. XXXVIII. fig. 10). The edges are free rounded projections containing no Ascidiozooids. Over the rest of the surface the Ascidiozooids are closely placed. They are conspicuous externally and form small circular grey dots about 0·25 mm. to 0·30 mm. in diameter. The common cloacal apertures are 1 mm. to 1·5 mm. in length.

The spicules in the test are very abundant. They vary a little in size, but are very regular in form (Pl. XXXVIII. fig. 13); no spherical spicules were noticed. In the surface layer of test the spicules are less crowded over the bodies of the Ascidiozooids than between them (Pl. XXXVIII. fig. 11), consequently the appearance of a strong network with circular spaces is produced just as in the case of *Leptoclinum tenue* and some other species, but in the present case the areas occupied by the Ascidiozooids are relatively much smaller, and the dark masses of test between are larger (Pl. XXXVIII. fig. 11). The edges of the six lobes surrounding the branchial apertures are strengthened by lines of closely placed spicules (Pl. XXXVIII. fig. 12); the base of the lobe has generally few or no spicules.

The branchial sphincter is very large (Pl. XXXVIII. fig. 12, *sph.*), but otherwise the muscular system is not strong.

The branchial sac has long stigmata with pointed ends. They are regularly arranged, and their ciliated ends are large, and have pointed free ends. The endostyle is large and conspicuous. Its course is slightly undulating.

The nerve-ganglion is an ellipsoidal mass, placed close to the peripharyngeal band.

The stomach is small. The intestine is long and narrow, and the intestinal loop is very slight, the rectum being placed close to the intestine and stomach. The rectum contains dark-coloured fæcal pellets. The testis is large and has a spirally coiled vas deferens. No ova and no embryos were discovered in the colony.

Leptoclinum albidum, Verrill (?).

> *Leptoclinum albidum*, Verrill, Brief Contributions to Zoology, &c., Amer. Journ. Sci. and Arts, ser. 3, vol. i. No. 6, p. 443, June 1871.

The Colony is a thin expanded layer of irregular shape. It is incrusting, and is attached by its entire extent. The upper surface is uneven but moderately smooth. The colour is a dull greyish-white.

The length is about 5 cm., the breadth about 3 cm., and the thickness about 1 mm.

The Ascidiozooids are very numerous and of rather small size. They are usually distributed evenly over the upper surface of the colony. Common cloacal apertures are usually visible. The Ascidiozooids are placed nearly vertically in the colony, and their bodies are divided into two regions—thorax and abdomen.

The Test is not very hard; it is flexible, but tears easily. It is of a dirty white colour, and is opaque. The matrix contains the usual small test cells, and also large numbers of stellate calcareous spicules, which are most closely placed in the regions between the anterior ends of the Ascidiozooids. In the deeper parts of the test they are not so abundant as in the superficial layer.

The Mantle is moderately strong and muscular.

The Branchial Sac is large and well developed. The stigmata are long, and are arranged with regularity.

The Endostyle is conspicuous.

The Dorsal Lamina is represented by a series of long languets.

Localities.—(*a*) Off San Iago, Cape Verde Islands; depth, 100 to 125 fathoms (one colony). (*b*) Off San Iago, Cape Verde Islands; depth, 10 to 20 fathoms (one colony). (*c*) Simon's Bay, Cape of Good Hope; depth, 10 to 20 fathoms (several colonies).

There are a number of specimens of *Leptoclinum* in the Challenger and "Porcupine" collections which are either very closely allied to or identical with Verrill's *Leptoclinum albidum*. In 1871[1] Professor Verrill described briefly, without figures, the species *Leptoclinum albidum* and its variety *luteolum*.[2] I have been enabled to examine several specimens of both these forms from the collections sent out to museums by the United States Commission of Fish and Fisheries, and the new specific description which I have considered it necessary to give above is derived partly from these American specimens and partly from those in the Challenger collection.

A specimen obtained during the Challenger Expedition, off San Iago, Cape Verde Islands, from a depth of 100 to 125 fathoms, agrees closely with preserved specimens both of *Leptoclinum albidum* and of *Leptoclinum albidum*, var. *luteolum*. It measures about 3·5 cm. in length and 2 cm. in breadth, and is very thin, scarcely 1 mm. in the thickest part, and in many places much less. It occurs incrusting a lump of Sponge, over which it has spread irregularly. There is also a very small colony of probably the same species attached to the Sponge.

The Ascidiozooids are moderately large and rather conspicuous. They are placed slightly further apart than is usual in *Leptoclinum albidum*. They are of a greyer colour than the surrounding test. No common cloacal apertures are visible.

The test is opaque between the Ascidiozooids, and translucent over them, where there are fewer spicules present. The clearer areas thus formed on the surface of the colony are generally elliptical in shape and are about 0·4 mm. in the longer diameter.

[1] *Amer. Journ. Sci. and Arts*, ser. 3, vol. i. No. 6, p. 443.

[2] Named as a distinct species in the paper quoted.

The spicules are abundant, especially in the upper layers of the test between the Ascidiozooids. They are usually stellate, with tapering rays and sharp points, but here and there deformed and irregular forms occur. They are most of them slightly larger than those of the named specimen of *Leptoclinum albidum* in which I examined the spicules, but are exactly like those of the named *Leptoclinum albidum*, var. *luteolum*.

A small colony of roughly circular form and about 2 cm. across, which was obtained off San Iago, Cape Verde Islands, from a depth of 10 to 20 fathoms, seems also to belong to *Leptoclinum albidum*, Verrill. It is attached to some object in the form of a dome about 1·5 cm. high, which it closely incrusts. The colony is slightly thicker, and the test seems a little whiter and more opaque than in the case of the specimen from deeper water in the same neighbourhood, but in other respects the structure is the same.

One large colony and a few smaller ones and some fragments which were obtained in Simon's Bay, Cape of Good Hope, from a depth of 10 to 20 fathoms, differ very slightly from those above described. They are of very irregular shape, and are thicker (from 1 to 3 mm.) than the specimens from Cape Verde Islands. They are also more opaque and not so grey in colour. The markings on the upper surface caused by the anterior ends of the Ascidiozooids are in some places rather smaller and more irregular, but in other parts of the colony they are of the normal size.

The spicules both in shape and arrangement differ somewhat from those of both the North American and the Cape Verde Island specimens; they are rather larger, and are decidedly more irregular both in shape and distribution. Some of them are of a regular stellate form, but spherical, mammillated, and quite irregular spicules are of common occurrence throughout the test. Some of the larger irregular spicules are composed of several fan-shaped pieces joined together to form an incomplete disk which is marked by concentric and radial lines exactly like those on the discoid spicules of *Cystodytes*. This peculiar form of spicule occurs also in *Leptoclinum subflavum* (see p. 294, and Pl. XXXVIII. fig. 16).

In the specimens from Simon's Bay, as in those from the Cape Verde Islands, the Ascidiozooids are distributed more or less evenly over the surface, and show no arrangement into systems or lines; but in those colonies allied to *Leptoclinum albidum* which still remain to be considered, the anterior ends of the Ascidiozooids form on the upper surface a well marked reticulum composed of branching and anastomosing lines. This arrangement seems also to be generally found in Verrill's *Leptoclinum albidum*, var. *luteolum*, though not so markedly in the species itself. As all the specimens I have examined have been preserved in alcohol, unfortunately colour cannot be made use of as a distinguishing character.

Leptoclinum albidum, var. *luteolum*, Verrill (?) (Pl. XL. figs. 10–15).

Leptoclinum luteolum, Verrill, Brief Contributions to Zoology, &c., Amer. Journ. Sci. and Arts, ser. 3, vol. i. No. 6, p. 443, June 1871.

Half a dozen colonies obtained during the cruise of the "Porcupine" in Tangier Bay, on the coast of Morocco, on August 5, 1870, from a depth of 35 fathoms, resemble closely the named specimens of Verrill's *Leptoclinum albidum*, var. *luteolum*. What the colour was when living is unknown; after fifteen years' preservation in alcohol it is a dull greyish-white, with darker lines running along the rows of Ascidiozooids.

The shape of the colonies is irregular (Pl. XL. figs. 10, 11). They are incrusting, and are attached by the greater part of the lower surface. The edges are rounded and projecting; they contain no Ascidiozooids. The thickness is considerable. It may extend up to 4 mm. In such a case the Ascidiozooids occupy only the upper 2 mm. or so of the colony, and the lower half is solid test.

The Ascidiozooids are fairly numerous, but small. They are placed vertically in the test, and their anterior ends are visible as minute rounded dots on the surface. They are so arranged that their anterior ends form lines which branch and unite at fairly equal distances so as to form a close network over the surface (Pl. XL. fig. 10). Each line is really formed of two rows of Ascidiozooids closely placed and running parallel. Between the rows is found a canal-like extension of one of the common cloacal cavities, while the meshes of the network are formed by areas of test towards which the ventral surfaces of the surrounding Ascidiozooids are turned. This arrangement in linear and branched systems is exactly the same as that found in many species of the genus *Botrylloides* (see p. 40, and Pl. I. fig. 4). In museum specimens of *Leptoclinum albidum*, var. *luteolum*, Verrill, from North America, the same arrangement of the Ascidiozooids is seen, but it is usually not so well marked as in the colonies from Tangier Bay, figured on Plate XL.

The common cloacal apertures are numerous and conspicuous (Pl. XL. figs. 10, 11). They are ovate or elliptical slits, generally about 2 mm. in length and 1 mm. across at the widest point. The surface of the colony is uneven and rather rough.

The test is of considerable thickness, and is hard and firm. The matrix is closely crowded with test cells and spicules. A few bladder cells are also present in some parts. The test cells are rather large. They are of rounded and ovate forms and are granular. The spicules are stellate and fairly regular (Pl. XL. fig. 12).

The mantle is moderately muscular, the branchial sphincter is well developed, and there are strong retractor muscle bands running along the dorsal edge of the thorax.

The branchial sac is long and narrow. The stigmata are large and are arranged in three rows separated by wide transverse vessels. The endostyle is very large and conspicuous. The dorsal languets are long and narrow.

Both ova and a testis were found in the abdomen of the Ascidiozooids. The vas deferens is coiled spirally around the testis. Several very large tailed larvæ (Pl. XL. fig. 13) were also found in the colony. In these the young test is very distinctly broken up into a network by numerous polygonal bladder cells (see Pl. XL. figs. 13, 14). The tail and its urochord are both very distinct, although the larva figured is evidently in an advanced stage of development; the three rows of stigmata in the branchial sac are already formed. Two pigmented sense organs are present, and the larva is provided at its anterior end with three well-developed adhering organs (Pl. XL. figs. 13, 15; the latter figure shows the termination of one of the adhering organs on the surface of the test, highly magnified).

I have given these details in regard to the specimens from Tangier Bay, as they may possibly turn out to be distinct from Verrill's variety, although they are certainly closely allied to it. To decide the matter both forms would require to be examined in the living condition.

Leptoclinum albidum, var. *grande*, nov. (Pl. XXXV. figs. 11–14).

The Colony is a large incrusting mass prolonged at its edges into considerable lobes and ridges with rounded ends. It is attached by the entire lower surface. The upper surface is uneven and is slightly rough all over. The colour is opaque whitish-grey.

The length is 8·5 cm., the greatest breadth is 6·5 cm., and the thickness varies from 1 mm. to nearly 1 cm.

The Ascidiozooids are very numerous but small. They are arranged so as to form a close reticulum over the whole surface. A few common cloacal apertures are visible. The Ascidiozooids are placed vertically in the test. In the thickened portions they only occupy the outer layer of the colony. Their branchial apertures occupy slight rounded projections on the surface.

The Test is hard and firm. It is relatively of large amount. It is of a dull greyish-white colour, and is quite opaque throughout. The matrix is densely crowded with calcareous spicules in all parts except in the immediate neighbourhood of the branchial apertures. Test cells are also abundant in the matrix; they are of very small size, and are mostly rounded in form. No bladder cells are present. The spicules are large and are of regular stellate shape. The rays are long and have sharp points.

The Mantle is rather thick and muscular. The branchial sphincter is well developed, and there are retractor muscles on each side of the body.

The Branchial Sac is small. The stigmata are short, but regularly arranged.

The Endostyle is narrow. Its course is straight.

The Alimentary Canal is of small size.

Locality.—Station 209, January 22, 1875; lat. 10° 14′ N., long. 123° 54′ E.; depth, 95 fathoms; bottom, blue mud; bottom temperature, 71° F.

One large colony and several fragments of this well-marked variety were obtained from a depth of 95 fathoms at Station 209, off Zebu, in the Philippine Islands. It is closely allied to *Leptoclinum albidum*, Verrill, and in the arrangement of the Ascidiozooids it resembles Verrill's variety *luteolum*, but it has certainly sufficient peculiarities of its own to warrant its being considered as a distinct variety, if not a separate species.

The large colony is a magnificent specimen (see Pl. XXXV. fig. 11). It is the largest of the Didemnidæ in the collection. It is an incrusting mass which is attached to a large Lamellibranch, over which it has grown so as to completely bury both sides of the shell with the exception of a small area at one end of the hinge-line. At the opposite end of the colony, corresponding to the ventral edge of the shell, there is a narrow line across which the Ascidian is not continuous from side to side. Union has evidently been prevented from taking place in this region by the opening and closing of the mouth of the shell, so as to form a passage by which water might reach the Lamellibranch inside. The upper end of the colony and some parts of the surface are prolonged into rounded ridges and finger-like lobes with blunt ends (Pl. XXXV. fig. 11). The average thickness of the colony is probably about 3 or 4 mm., but in some places it is three times as much.

At the base (the dorsal edge of the shell) for a short distance there is a thin expanded edge formed in which no Ascidiozooids are present, and the test is very thin. Over the rest of the colony on both sides the Ascidiozooids are exceedingly numerous. They are arranged very much as in *Leptoclinum albidum*, var. *luteolum*, so as to form a close network of lines over the surface (Pl. XXXV. fig. 11). These lines are of a greyer colour than that of the test in the meshes, and they are occupied by canal-like extensions from the common cloacal cavities. The Ascidiozooids border the lines, but are also placed here and there in the meshes, which are not so large as in the specimens of *Leptoclinum albidum*, var. *luteolum* from Tangier Bay (p. 290, Pl. XL. figs. 10, 11). Consequently, although a general view of the colony gives the impression that the Ascidiozooids occupy merely the edges of the branching lines (Pl. XXXV. fig. 11), a closer examination shows that in most places they are really scattered closely all over the surface (Pl. XXXV. fig. 12), and that the grey lines formed by the cloacal canals wind in and out between them.

The Ascidiozooids are small, and do not extend far into the test. Both thorax and abdomen are short. The branchial apertures project slightly above the general surface and cause a rough appearance. A surface view of the colony under a low power of the microscope shows (Pl. XXXV. fig. 12) the numerous open branchial apertures of the Ascidiozooids surrounded each by two circles, the outer of which is the

place where the spicules in the surface layer of the test over the Ascidiozooid become greatly reduced or altogether cease, while the inner is the branchial sphincter.

The distribution of the spicules in the surface layer of test is also distinctly seen in a low power view of the colony (Pl. XXXV. fig. 12). They are most abundant between the bodies of the Ascidiozooids, where the dark opaque lines form a network with fairly regular hexagonal meshes. The regions occupied by the Ascidiozooids are thus clearly marked out (Pl. XXXV. fig. 12). A higher magnification shows that the branchial aperture is irregularly six-lobed (Pl. XXXV. fig. 13, *br.*). The bases of the lobes are usually strengthened by a few spicules, which are arranged in two, three, or four groups (generally three); these are shown as small dark masses on the line of the sphincter muscle in figure 12.

The spicules have the rays more tapering and the apices sharper (Pl. XXXV. fig. 14) than is usual amongst allied forms. The mantle has both transverse and longitudinal muscle bands (Pl. XXXV. fig. 13).

The branchial sac has small but well-formed stigmata; the ciliated cells are distinct. The testis is large, and the vas deferens is spirally coiled around it. No ova nor embryos were discovered in the colony.

Leptoclinum subflavum, n. sp. (Pl. XXXVIII. figs. 14–18).

The Colony is a thin incrusting layer of irregular shape, attached by its entire extent. The upper surface is even, but rather rough. The colour is yellow.

The length is about 2·5 cm., the breadth about 2 cm., and the thickness is less than 1 mm.

The Ascidiozooids are moderately large, and fairly numerous. They are closely placed all over the surface, and are not arranged in definite systems. No common cloacal apertures are visible.

The Test is rather firm. It is of a greyish-yellow colour and is transparent. The matrix is crowded with test cells which are mostly of large size and rounded form. Calcareous spicules are also present, but they are most irregular in size and shape. They are never stellate.

The Mantle is moderately strong. The muscle bands are delicate but numerous. They are mostly longitudinal in direction, and are placed regularly.

The Branchial Sac is rather small and is thick-walled. The stigmata are usually small, but are arranged with regularity. There are four rows. The ciliated cells are distinct.

The Dorsal Lamina is represented by a series of rather short tentacular languets.

The Tentacles are short and stout. There are from twelve to sixteen of them.

The Alimentary Canal is moderately large. It forms a short loop.

Locality.—Kerguelen Island; depth, 28 fathoms.

This is a small incrusting species, a specimen of which was found attached to the test of a large Simple Ascidian from Kerguelen Island. It is quite flat (Pl. XXXVIII. fig. 14), and the edges are expanded. The colour is a warm yellowish-grey.

The Ascidiozooids are conspicuous (Pl. XXXVIII. fig. 14). They form slight rounded elevations all over the surface, and are closely placed. Their bodies are nearly 1 mm. in greatest breadth. They are divided into two regions, thorax and abdomen (Pl. XXXVIII. fig. 15).

The test cells are mostly of very large size. In some places smaller ones occur aggregated together in spherical or ellipsoidal clumps. All these cells stain deeply with carmine, and so give the test a minutely dotted appearance under a low power. A few vascular appendages are found in the test; they are narrow and straight, and have long ovate swellings at their ends.

The spicules are fairly abundant. They are more numerous near the upper and lower surfaces than in the deeper parts of the test, and are of most irregular form (Pl. XXXVIII. fig. 16). The smaller ones are usually more or less rounded. The larger ones, which attain to 0·3 mm. in length, are discoid or ellipsoidal or lobed. No regular spherical or stellate spicules were discovered. Many of the larger spicules are marked by radiating and concentric lines (Pl. XXXVIII. fig. 16) like those seen still more distinctly in the large discoid spicules of *Cystodytes*.

The mantle is rather opaque, and is fairly muscular. The branchial siphon is large (Pl. XXXVIII. fig. 15), and the sphincter is well developed. In addition to the delicate longitudinal and transverse muscle bands, which are closely placed all round the body, there are two strong bands which run longitudinally down the dorsal edge of the thorax. They are separated by a narrow clear space which is the median dorsal line, and from which the dorsal languets project inwards.

The branchial sac is rather strong, the stigmata being narrow and the vessels rather wide (Pl. XXXVIII. figs. 15, 17). The transverse vessels are provided with bundles of muscle fibres (Pl. XXXVIII. fig. 17, *m.f.*). The stigmata vary greatly in length. In some cases they are much longer than those represented in the figure (Pl. XXXVIII. fig. 17, *sg.*).

The tentacles are irregular. None of them are long, but some are larger than others (Pl. XXXVIII. fig. 18). They are not arranged according to size, and they vary also in number in the different Ascidiozooids.

The alimentary canal forms a rounded mass placed close behind the branchial sac (Pl. XXXVIII. fig. 15), so that the body, as a whole, is short and compact. The stomach is not large; it is smooth-walled. The intestine is short but wide.

The reproductive organs were not well developed in any of the Ascidiozooids examined. The vas deferens coils spirally around the testis.

Leptoclinum jeffreysi,[1] n. sp. (Pl. XL. figs. 6–9).

The Colony is a flattened expansion of irregular form. It is incrusting, and is attached by the whole of the lower surface. The upper surface is somewhat uneven but smooth. The colour is a dull creamy white.

The length is 3·5 cm., the breadth is about 2 cm., and the thickness is from 1 to 2 mm.

The Ascidiozooids are fairly numerous, but of small size. Their anterior ends are visible on the upper surface as small inconspicuous dots. They seem to be scattered evenly over the colony. No common cloacal apertures are visible.

The Test is hard and brittle. It is of a white colour and quite opaque. The upper surface contains great numbers of calcareous spicules, while the lower part is crowded with large bladder cells, and has no spicules. Small test cells are scattered all through the matrix, but they are not numerous. The spicules are stellate, but their rays are short and wide. They are of a slightly yellow colour.

The Mantle is thin and not strongly muscular. The branchial sphincter is strong.

The Branchial Sac is small and feebly developed.

The Endostyle is conspicuous.

Locality.—Tangier Bay, Morocco, August 5, 1870; depth, 35 fathoms.

One colony of this species was obtained during the Mediterranean cruise of the "Porcupine," in the summer of 1870, in Tangier Bay, from a depth of 35 fathoms. It is a small irregularly shaped expansion of a dirty cream colour, and having various fragments of Polyzoa and sand grains attached to its lower surface and edges (Pl. XL. fig. 6). The Ascidiozooids are small and inconspicuous. They occupy only the upper half or so of the thickness of the colony (Pl. XL. fig. 7), and they are not arranged in definite systems.

Vertical sections through the colony show that the test may be divided into two zones (see Pl. XL. fig. 7); an upper containing the bodies of the Ascidiozooids, and densely crowded with calcareous spicules, and a lower into which the Ascidiozooids do not extend, and which contains no spicules, but is occupied by a large number of bladder cells (Pl. XL. figs. 7, 8). The bladder cells are usually spherical, but in some places they become polygonal from mutual pressure. They do not extend quite to the lower surface of the colony (Pl. XL. fig. 8, *l.s.*).

The spicules are of moderate size and usually of stellate form, but the rays are very short and wide and the central part is large, so that the spicule as a whole has often the appearance of a sphere covered with small pointed excrescences. The spicule

[1] This species and the two following ones are named in honour of the three distinguished naturalists who conducted the scientific investigations during the cruises of H.M.SS. "Lightning" and "Porcupine" in the summers of 1868, 1869, and 1870—the late Dr. Gwyn Jeffreys, the late Dr. W. B. Carpenter, and the late Sir Wyville Thomson.

figured (Pl. XL. fig. 9) is one of the larger and more regularly stellate ones. Many of the others are much smaller and more spherical. The spicules have a slight yellow colour, which probably gives the creamy tint to the colony as a whole.

The testis is a large globular mass around which the vas deferens is coiled spirally. Part of the vas deferens is seen in the section figured (Pl. XL. fig. 7, at the right hand side of the figure).

Leptoclinum carpenteri, n. sp. (Pl. XLI. figs. 1–4).

The Colony forms an irregularly ovate or rounded mass, incrusting, but not flattened. Its surface is fairly even and quite smooth. The colour is a dull white.

The length is about 1·5 cm., the breadth about 1 cm., and the thickness about 0·5 cm.

The Ascidiozooids are inconspicuous and show no definite arrangement in systems. No common cloacal apertures are visible. The body of the Ascidiozooid is slightly elongated vertically, and is distinctly divided into two regions—thorax and abdomen.

The Test is soft and flexible. It is of a greyish-white colour, and is almost quite opaque. In sections the structureless matrix is seen to contain large numbers of very minute test cells, and a comparatively small number of calcareous spicules. The spicules are of regular stellate form, but vary considerably in size.

The Mantle is transparent, but is of moderate strength over the thorax. It has fine muscle bands running both longitudinally and transversely.

The Branchial Sac is short but wide. It has four rows of moderately long stigmata. The transverse vessels are rather wide, and are provided with muscle fibres.

The Alimentary Canal is long and narrow, it forms a wide loop. The stomach is short and rather quadrate in outline.

Locality.—Unknown.

Several specimens of this species were found during one of the cruises of the "Porcupine" attached to Algæ along with specimens of *Leptoclinum thomsoni* (see Pl. XLI. fig. 1, where B. represents the present species). The exact locality from which the specimens were obtained is not known.

The colonies are all more or less rounded masses of considerable thickness which have grown around the Algæ. They are readily distinguished from the similar specimens of *Leptoclinum thomsoni* by being much softer and more flexible, and by the colour, which in the present species is a dirty white with a slight greyish tint. The Ascidiozooids also are not nearly so distinct as in the case of *Leptoclinum thomsoni* (compare A. and B., Pl. XLI. fig. 1).

The surface of the colony is smooth and soft, and sections show (Pl. XLI. fig. 2) that the superficial layer is formed of test only and contains no spicules.

The Ascidiozooids, although of fair size, are in most places not visible on the exterior of the colony (Pl. XLI. fig. 1, B.), but in a few spots they can be made out as small white rounded areas. The body as a whole is elongated antero-posteriorly, and is placed at right angles to the surface (Pl. XLI. fig. 2). The abdomen is rather larger than the thorax.

The test is relatively large in amount, and is remarkably soft and flexible for a Leptoclinid. The test cells are very numerous, and are mostly of small size and of rounded or fusiform shapes; here and there, however, larger test cells of stellate and branched forms occur (Pl. XLI. fig. 3, *t.c.*).

The spicules are much less numerous than in most species of *Leptoclinum* (Pl. XLI. figs. 2, 3). Some of them are twice or even three times as large as others, but they are all stellate in form, and their rays are regular and pointed at the apices (Pl. XLI. fig. 3, *sp.*). A vertical section through the colony (see Pl. XLI. fig. 2), shows that the spicules are not equally scattered all through the test, but are most abundant immediately around the anterior ends of the Ascidiozooids. At this level the spicules form a continuous dense band stretching throughout the section, becoming thickened in the neighbourhood of each Ascidiozooid and thinning out in the intermediate regions. Above this band the superficial layer of test, as we have already seen, contains no spicules (Pl. XLI. fig. 2, *t.m.*); while below, in the deeper parts of the colony, spicules are present, but they are scattered sparsely and evenly through the test.

Retractor muscle bands and ectodermal processes from the Ascidiozooids are also met with in the test (Pl. XLI. figs. 2, 3, *m.b.*, *v.*). The latter are given off from the œsophageal region of the body where the thorax and the abdomen join, and they run mainly in a posterior direction, towards the centre of the colony. They are not very long and do not give off any branches. Their ends are rounded and slightly dilated (Pl. XLI. fig. 3, *v.*).

The branchial siphon is lined by test which contains spicules (Pl. XLI. fig. 2). The sphincter surrounding it is well marked. The endostyle is large and conspicuous. The branchial sac is remarkably wide dorso-ventrally, usually it is as wide as or wider than its antero-posterior length. The stigmata are well formed (Pl. XLI. fig. 4), and the muscle bands in the transverse vessels are unusually strong. In one of the Ascidiozooids shown in the section (Pl. XLI. fig. 2), only three rows of stigmata were visible in the branchial sac. The posterior end of the branchial sac is very wide and flat, and it is from this region, between the posterior extremity of the endostyle and the œsophageal opening, that the ectodermal processes or vessels arise (Pl. XLI. fig. 2).

The œsophagus commences at the dorsal edge of the posterior end of the branchial sac and runs straight backwards for a short distance to open into the short, and, in some cases, almost cubical stomach (see Pl. XLI. fig. 2). There is a certain amount of variability in the form of the stomach even in Ascidiozooids of the same colony. The

second Ascidiozooid represented in the figure shows an ovate stomach with the long axis antero-posterior, and the posterior end narrow. In transverse sections the lumen of the stomach is seen to be cruciform (Pl. XLI. fig. 2, *st.*). This is produced by the presence of four longitudinal pads of thickened epithelium. The intestine is long. It runs posteriorly from the stomach and then turns ventrally in rather a wide curve, and before turning anteriorly it becomes more or less distinctly thickened for a short distance (Pl. XLI. fig. 2, where the Ascidiozooid at the left side of the figure shows the thickening more than usually distinct, and forming a considerable enlargement on the intestine). From this point the rectum runs anteriorly and dorsally so as to reach the œsophagus which it crosses. The intestinal loop is wide.

The testis, in the form of a single large ovate mass (Pl. XLI. fig. 2, *t.v.*), was present in some of the Ascidiozooids examined, but no ova and no embryos were discovered in any part of the colony.

Leptoclinum thomsoni, n. sp. (Pl. XLI. figs. 1, 5–7).

The Colony is an irregular mass, incrusting and rather flat. The surface is moderately even and smooth. The colour is opaque white.

The length is about 2 cm., the breadth about 0·7 cm., and the thickness 2·5 mm.

The Ascidiozooids are numerous but small. They are distributed evenly over the surface of the colony, and are not arranged in regular systems. No common cloacal apertures are visible. The body of the Ascidiozooid is divided into two distinct regions, thorax and abdomen.

The Test is hard and firm. It is of a creamy white colour, and is quite opaque. In sections the clear structureless matrix is seen to contain a few delicate test cells and a large number of calcareous spicules. The spicules are fairly large, and are of very regular stellate form. In some places they are densely crowded.

The Mantle is rather muscular. It has both longitudinal and transverse bands.

The Branchial Sac is moderately large. It has three or four rows of large stigmata which are arranged with regularity. The transverse vessels are provided with muscle fibres.

The Endostyle is large and conspicuous. Its course is greatly convoluted.

The Dorsal Lamina is represented by a series of languets.

The Alimentary Canal is large. The stomach is fusiform and smooth-walled.

Locality.—Unknown.

Some colonies of this species were found attached to Algæ, along with specimens of *Leptoclinum carpenteri*, during one of the cruises of the "Porcupine." The exact locality is unknown.

The colonies are of irregular shape (see Pl. XLI. fig. 1, where A. represents the present species), and are not so rounded as those of *Leptoclinum carpenteri* (Pl. XLI. fig. 1, B.). They are also flatter and more spreading, of a slightly whiter colour, and much harder and firmer, and not so smooth to the touch, consequently there is no difficulty in distinguishing the two species even by their external characters only. The Ascidiozooids also are clearly visible in the present species, which is not the case in *Leptoclinum carpenteri* (see Pl. XLI. fig. 1, A. and B.). The branchial apertures lie in minute depressions which are closely placed all over the surface of the colony.

The colonies are of various sizes, from a few millimetres to 2 centimetres in length. They are all attached to parts of the Alga, around which they have grown so as to completely imbed it. The surface of the colony feels hard and slightly rough, but no projections are visible. Vertical sections show (see Pl. XLI. fig. 5) that as in the case of *Leptoclinum carpenteri* the superficial layer is formed of test containing no calcareous spicules.

The Ascidiozooids as a general rule are placed at right angles to the surface of the colony, but in some cases they are inclined at an angle to it. The abdomen is sometimes not directly posterior to the thorax, but is bent upwards so as to lie partially on its dorsal edge (Pl. XLI. fig. 5, right hand side).

The test is, relatively to the size of the colony, not so large in amount as in the case of *Leptoclinum carpenteri*. It has the characteristic Leptoclinid stiffness and opacity. The test cells are inconspicuous, but the spicules are very abundant (see Pl. XLI. figs. 5, 7). In some places they are even more numerous than is represented in figure 5. A few bladder cells are present in the outer part of the test in some places. The spicules are very regular. The rays are usually wide at the base, and curve gently upwards to the pointed apex (see Pl. XLI. fig. 6). Rarely an irregular spicule is seen like one of those shown in figure 6, where one ray is larger than the others. In some cases the rays are narrower than usual, and the apices are much sharper.

A vertical section through the colony (Pl. XLI. fig. 5) shows that below the superficial layer composed of test only (*t.m.*), occurs a wide zone (*sp.*) in which the spicules are closely placed. This region surrounds the greater part of the thorax of the Ascidiozooids. It varies somewhat in width, but is always considerably wider than the corresponding zone in *Leptoclinum carpenteri*. In the deeper parts of the colony spicules are present in the test, but they are not very numerous and are scattered evenly.

The muscles of the mantle are well developed and run in various directions (Pl. XLI. fig. 5). The branchial siphon is large, and the test lining it contains spicules (Pl. XLI. fig. 5, *br.*). The sphincter is well developed, and from its posterior edge two bands of muscle fibres arise on each side, one near the dorsal and the other near the ventral edge of the siphon. These muscle bands run posteriorly over the surface of the thorax, and soon join (see Pl. XLI. fig. 7) to form a single band which continues to run backwards

along the thorax near the dorsal edge until it reaches the œsophageal aperture, around which it curves so as to meet and join its fellow of the opposite side on the posterior surface of the œsophagus (Pl. XLI. fig. 5). From this point the single muscle band runs downwards into the test below the Ascidiozooid, where it gradually spreads outwards and ends. In all probability this is a retractor muscle for drawing the anterior end of the Ascidiozooid downwards into the colony. It would probably also compress the branchial sac so as to expel the contained water, and would at the same time help to tighten the branchial sphincter, with which it is continuous anteriorly.

Sections of this retractor muscle are met with occasionally in sections of the test (Pl. XLI. fig. 5), and more rarely short ectodermal vessels with dilated bulbous ends are seen. The latter form of appendage is very short in this species. It springs from the region of the œsophageal aperture, and runs posteriorly or dorsally (Pl. XLI. figs. 5, 7, *v.*)

The branchial sac is short and wide. Its dorsal edge is straight, and its ventral edge is curved. The stigmata are large. They are not quite so numerous as in *Leptoclinum carpenteri*. The ciliated cells are distinct; and they are columnar in shape. The endostyle is particularly large and convoluted (Pl. XLI. fig. 7, *en.*). The dorsal languets are few but large. They are of elongated triangular form.

The œsophagus arises at the dorsal edge of the posterior end of the branchial sac, and at first runs dorsally so as to pass through the loop formed by the two branches of the retractor muscle (Pl. XLI. figs. 5, 7, *œ.*). It then turns posteriorly to open into the large fusiform stomach. Transverse sections show the stomach as a simple circular cavity without any ridges or other thickenings on its wall. The intestine is narrow and simple. It lies alongside the stomach and œsophagus, and consequently the intestinal loop is narrow.

Sections of the large rounded testis were found in some of the Ascidiozooids, but no ova and no embryos were discovered in any part of the colony.

Leptoclinum edwardsi,[1] n. sp. (Pl. XXXIX. figs. 12–15).

The Colony is of irregular form, and is attached by the whole of the lower surface. The upper surface is convex and moderately smooth. The colour is grey.

The length is about 3 cm., the breadth is 7 mm., and the thickness is about 3 mm.

The Ascidiozooids are fairly large and numerous. They are distributed evenly over the surface, and do not form definite systems. A few common cloacal apertures are present. The body of the Ascidiozooid is placed vertically in the test, and is divided into two regions, thorax and abdomen.

The Test is firm but not hard. It is of a warm greyish colour, and is nearly opaque. The matrix is densely crowded with large granular test cells and with calcareous

[1] Named in honour of the late Professor H. Milne-Edwards who founded the genus *Leptoclinum*.

spicules. A few bladder cells are present in some parts of the test. The spicules are large and rather irregular in shape. They are mostly stellate, but the rays are often of different sizes and of irregular form.

The Mantle is strong. Both longitudinal and transverse bands are present.

The Branchial Sac has four rows of small stigmata. The transverse vessels are wide, and have muscle fibres.

The Tentacles are numerous, they are of two sizes, and are placed alternately.

Locality.—Station 142, December 18, 1873; lat. 35° 4′ S., long. 18° 37′ E.; depth, 150 fathoms; bottom, green sand; bottom temperature, 47° F.

Several small colonies of this species were dredged at Station 142, to the south of the Cape of Good Hope; the two largest are figured (Pl. XXXIX. figs. 12, 13). They are of irregular form and are attached to worm tubes, Polyzoa, and other objects which they have grown completely around. The colonies are of considerable thickness for their size. They are quite opaque, and are of a warm grey colour with a slight yellowish tinge in places.

The Ascidiozooids show externally as small circular lighter coloured dots (Pl. XXXIX. figs. 12, 13) less than 0·5 mm. in diameter. The common cloacal apertures are slit-like, and are rather more than 1 mm. in length.

The test cells are unusually large and conspicuous. They are mostly of rounded forms and are very granular. The spicules are irregular in shape, size, and distribution (Pl. XXXIX. fig. 15). As a rule, however, they are more abundant in the surface layer of test than deeper down. They are not arranged so as to mark out Ascidiozooid areas as they are in *Leptoclinum tenue* and some other species. The spicules even in the surface layer of the test are not so numerous as they are in most colonies of the Didemnidæ.

The branchial sac is fairly large. At its posterior end there is a part of its wall lying behind the fourth row of stigmata, and about equal to two rows of stigmata in breadth, which is not pierced by any apertures (Pl. XXXIX. fig. 14). The stigmata are short, some of them are nearly circular, and they are sometimes placed irregularly. The ciliated cells are distinct. The muscle bands in the transverse vessels are unusually strong (Pl. XXXIX. fig. 14, *tr.*). There are usually eleven or twelve stigmata in the widest row. In one sac examined there were five rows on each side, but some of the stigmata were irregular. The branchial siphon is small, but the sphincter is fairly strong.

The endostyle is long and narrow. Its course is straight (Pl. XXXIX. fig. 14, *en.*) The tentacles are rather large and numerous.

The alimentary canal is moderately large. It forms a long narrow loop. The stomach is small. The rectum contains dark-coloured fæcal pellets. It crosses the abdomen and lower part of the thorax obliquely from the ventral to the dorsal edge.

Leptoclinum japonicum, n. sp. (Pl. XXXIX. figs. 1–7).

The Colony is massive and of rudely ellipsoidal form. It was attached by a rather small concave area on the lower surface. The upper surface is strongly convex. It is even and fairly smooth. The colour is a dark greyish-brown.

The length is 1·4 cm., the breadth is 2·2 cm., and the thickness is 7 mm.

The Ascidiozooids are small and very numerous. They are scattered evenly all over the surface of the colony. No common cloacal apertures are present. The bodies of the Ascidiozooids are rather short, they are divided into two regions, the thorax and the abdomen.

The Test is firm but not hard. It is of a greyish-brown colour and nearly opaque. The matrix is densely crowded with test cells, and contains also calcareous spicules. Bladder cells are present in some places. The spicules vary greatly in size and shape, and are only present in the upper layer of the colony.

The Mantle is moderately strong. The muscle bands are narrow but regular.

The Branchial Sac is well developed. There are four rows of short stigmata. The transverse vessels are moderately wide and have muscle fibres.

The Tentacles are short, and are irregular in size and arrangement.

The Alimentary Canal is not large. It forms a short wide loop.

The Reproductive Organs are conspicuous. The testis is large, and it has the long vas deferens coiled spirally around it.

Locality.—Station 233A, May 19, 1875; lat. 34° 38′ N., long. 135° 1′ E.; depth, 50 fathoms; bottom, sand.

One colony of this species was dredged off Kobé, Japan, from a depth of 50 fathoms. In external appearance it is not unlike *Leptoclinum jacksoni* from Australia, but the resemblance is merely superficial, and the colour is darker in the present species.

The colony is massive (Pl. XXXIX. figs. 1, 2). It has evidently been attached to some convex body, as the small area of attachment at the posterior end is decidedly hollow (Pl. XXXIX. fig. 2). The upper surface is smooth and rounded, and has the small Ascidiozooids distributed evenly over it. They show as small rounded spots of a lighter colour than the surrounding test (Pl. XXXIX. fig. 1).

The test is relatively large in amount. The matrix appears structureless. The test cells are very abundant and show a great variety in form (Pl. XXXIX. fig. 3, *t.c.*); fusiform, stellate and branched shapes predominate. Bladder cells, though present (Pl. XXXIX. fig. 3, *bl.*), are not very abundant.

The spicules are fairly numerous in the superficial layer of the colony, but become very scarce or disappear in the deeper parts. Figure 3 represents part of a section through the test deep down in the colony where the spicules are absent. The shape of the spicules varies very greatly (Pl. XXXIX. fig. 6). Most of them are stellate but irregular, having the rays of different sizes and shapes. Some simple forms are found

of fusiform shape,[1] or consisting of two, three, or four rays only. Deformed and monstrous spicules also occur (Pl. XXXIX. fig. 6).

The spicules in the superficial layer of test stop at a short distance from the branchial apertures (Pl. XXXIX. fig. 5), just at the bases of the six large lobes. The greater part of each lobe is free from spicules, but the margin is bordered by a single row, and the apex contains a small mass of closely placed spicules. The result of this arrangement is that the six rays or angles of the branchial apertures stretching out between the lobes are greatly emphasised, and are conspicuous in a low power view of the surface (Pl. XXXIX. fig. 5).

The musculature of the mantle is delicate but rather regular. Equidistant longitudinally running muscle bands are present on the thorax. At the anterior end they radiate from the base of the branchial siphon. The atrial siphon is placed on the dorsal edge of the thorax, half way down.

The transverse vessels of the branchial sac are provided with strong muscle bands (Pl. XXXIX. fig. 4, *tr.*). The stigmata are short, but numerous and regular. The ciliated cells are distinct (Pl. XXXIX. fig. 4, *sg.*).

The endostyle is large. The tentacles are of at least two sizes, but they are not arranged with regularity. The nerve ganglion is spherical. It is placed at the base of the branchial siphon.

The alimentary canal is rather narrow. The œsophagus leads posteriorly from the branchial sac to the small globular or quadrate smooth-walled stomach. The intestine runs posteriorly from the stomach for a short distance and then sweeps round anteriorly in a wide open loop. The rectum lies alongside the œsophagus.

The male reproductive organs are placed on the intestinal loop, behind which they project for a considerable distance, and so form the posterior end of the body. The testis is large and ovate, and the conspicuous vas deferens coils from six to eight times spirally around it (Pl. XXXIX. fig. 7, *v.d.*). No ova and no embryos were discovered in any of the Ascidiozooids examined.

Leptoclinum (*?*) *jacksoni*, n. sp. (Pl. XXXVIII. figs. 19–22).

The Colony is massive and of irregular shape. It is attached by the greater part of the lower surface, which is strongly concave. The upper surface is irregularly conical; it is fairly smooth. The colour is a dull greyish-white.

The length is 1·7 cm., the greatest breadth is 2·5 cm., and the greatest thickness is 1·2 cm.

The Ascidiozooids are small but very numerous. They are closely placed all over the

[1] Possibly these simple fusiform spicules are merely fragments of the ordinary stellate ones which have been broken off in cutting the sections.

surface, and are not arranged in definite systems. There are no common cloacal apertures visible.

The Test is very hard and firm. It is of a dull whitish colour and is opaque throughout. The matrix contains numerous test cells and calcareous spicules. No bladder cells are present. The spicules are stellate and regular, but they vary a good deal in size.

The Mantle is rather thick, and the musculature is well developed.

The Branchial Sac is small, and the stigmata are inconspicuous.

The Endostyle is very wide. Its course is somewhat undulating.

Locality.—Port Jackson, Sydney, Australia; depth, 6 to 15 fathoms.

One specimen of this species was dredged in Port Jackson, from shallow water. It is a small but massive colony, which has evidently been attached to some dome-shaped object, as there is a large hollow on the lower surface (Pl. XXXVIII. fig. 19). The area of attachment is very smooth; there are no projecting threads or tufts of test. The thickness given in the above description is measured across the base of the colony at right angles to the breadth. The distance from the point of attachment to the upper surface in the thickest place (the centre of the colony) is a little over 1 cm. The colour is a dirty cream tint; it is a mixture of white, yellow, and grey, and is quite opaque.

The Ascidiozooids are remarkably small, and are closely placed. They are not conspicuous, and show merely as minute depressions on the surface. In external appearance this species resembles *Leptoclinum japonicum* somewhat, but in that form the Ascidiozooids are much more distinct (see Pl. XXXIX. figs. 1, 2).

The test is solid and is relatively of large amount (Pl. XXXVIII. fig. 20). It is densely crowded with test cells, which are of rather large size and of various shapes (Pl. XXXVIII. fig. 21, *t.c.*). The spicules are fairly abundant in the superficial layer of test, but are scarce in the deeper parts of the colony (see Pl. XXXVIII. fig. 20). They are not arranged so as to define the Ascidiozooid areas as in some other species, but are distributed quite irregularly. The spicules vary greatly in size (Pl. XXXVIII. fig. 21, *sp.*), but are always more or less stellate in shape. In some places the matrix is distinctly fibrillated, but as a general rule it shows no structure. Large ovate or rounded granular cells are also present (Pl. XXXVIII. fig. 21, *p.c.*). These are pigment cells of a greyish-yellow colour, and they probably aid in rendering the test opaque.

The branchial siphon is small but well formed (Pl. XXXVIII. fig. 20, *br.*). The aperture is circular, and the sphincter is well developed. The musculature in general is strong. Retractor muscles are present which run downwards into the test Pl. XXXVIII. fig. 21, *v.ap.*)

The alimentary canal is small. It forms a narrow loop.

A number of large tailed larvæ were found in the colony. They are imbedded in the lower part of the test below the bodies of the Ascidiozooids. These larvæ have ellipsoidal

bodies and long tails (Pl. XXXVIII. fig. 22). The tail has a wide membranous fringe but no supporting transverse rays. About the middle of the body there are two closely placed pigmented sense organs, and three well-developed adhering papillæ are situated at the anterior end (Pl. XXXVIII. fig. 22).

Leptoclinum rubicundum, n. sp. (Pl. XXXIII. figs. 9–15).

The Colony forms an irregularly shaped and moderately flattened mass attached by a considerable part of the lower surface. The free end is rounded and slightly lobed. The surface is uneven and rough. The colour is a bright reddish-brown or rusty colour.

The length is 3·5 cm., the breadth is 2·5 cm., and the thickness is 7 mm.

The Ascidiozooids are rather small but numerous. They are scattered evenly over nearly the whole surface of the colony. The body is of rounded form, and is not distinctly divided into regions.

The Test is hard and tough. It is reddish-brown and quite opaque on the outer surface, whitish-grey and semi-translucent in the deeper parts.

The spicules are slightly yellow in colour and are stellate in form. They are of rather small size, but are abundant in the outer layers of the test. The test cells are small and rather scarce. They are usually of rounded or ovate form.

The Mantle is thin and transparent. Its musculature is rather feeble.

The Branchial Sac is moderately large and has the stigmata well developed. The transverse vessels are wide, and are provided with muscle bands. The stigmata are moderately long and are arranged with regularity.

The Endostyle is wide and conspicuous. Its course is straight.

The Tentacles are numerous but very short. There are about twenty of them; they vary in size, and are not arranged with great regularity.

The Dorsal Tubercle has a circular aperture of fair size.

Locality.—Station 149c, Balfour Bay, Royal Sound, Kerguelen Island, January 19, 1874; depth, 20 to 60 fathoms; bottom, volcanic mud.

A single specimen of this conspicuous species was collected in Royal Sound, Kerguelen Island. It is a small colony of irregularly conical form when laid on one side (Pl. XXXIII. fig. 9); and the area of attachment occupies more than half of the lower surface. The colour is peculiar. It is in most places a bright rusty brown, but in some parts it is much paler, becoming yellowish and almost white, while in others again it is darker.

Only one common cloacal aperture is visible on the upper surface. It is of elliptical form, about 2·5 mm. in length and 1 mm. across. No systems are present, the Ascidiozooids being placed at equal distances, with their centres usually about 1 mm. apart, all

over the surface (Pl. XXXIII. fig. 10). Just as in the case of *Didemnum aurantiacum*, the colour is confined to the superficial layer of the colony, where it forms a thin crust. In the present species, however, it is not the matrix alone that is coloured, as the spicules have a slight but distinct yellow tint.

The test is firm and nearly opaque even in the lower, almost colourless part of the colony. The spicules are very numerous in the upper part of the test (see Pl. XXXIII. fig. 11, *sp.*), and less abundant in the deeper parts. They are very regular in shape and size (Pl. XXXIII. fig. 12).

The Ascidiozooids, as seen in a surface view of the colony, are of elliptical or ovate shape (Pl. XXXIII. figs. 10, 11), and are inclined at an angle to the surface, so that the greater part of the ventral edge of the thorax, as well as the anterior end, is visible. The branchial aperture is usually distinctly seen (Pl. XXXIII. fig. 10, *br*) surrounded by a well-marked sphincter, and the short wide straight endostyle (Pl. XXXIII. figs. 10, 11, *en.*) is always a conspicuous object under a low power. The darker spaces between the bodies of the Ascidiozooids are formed of test containing closely-packed spicules (Pl. XXXIII. fig. 11).

The branchial sac is larger and the stigmata are more distinct (Pl. XXXIII. figs. 13, 14) than in most allied forms. The transverse vessels are regular, and the stigmata are numerous and of very fair size (Pl. XXXIII. fig. 14, *sg.*). The ciliated cells are distinct. Figure 13 on Plate XXXIII. shows part of the sac of a young Ascidiozooid where the stigmata are shorter and more rounded. In the specimen from which this figure was drawn there were no muscle fibres in the transverse vessels.

The dorsal and the ventral tentacles are longer than any of the others. The median lateral tentacles come next in size (see Pl. XXXIII. fig. 15). In each interspace between these four primary tentacles four shorter ones are usually present; these vary in length amongst themselves, and are not arranged with perfect regularity (Pl. XXXIII. fig. 15, *tn.*). It is interesting to find that the two largest tentacles in this Compound Ascidian are not in the same position as those which E. van Beneden and Julin have shown to be the first developed in the young Simple Ascidian,[1] and that the next largest pair (the medio-lateral) correspond to the pair which are developed first. The order of development in the Compound Ascidian is not known. In von Drasche's *Polycyclus violaceus* the medio-lateral tentacles are the largest.

The prebranchial zone is rudely circular in outline, the peripharyngeal bands are distinctly marked, and there is no peritubercular area (Pl. XXXIII. fig. 15). The anterior extremity of the large endostyle encroaches upon the ventral part of the prebranchial zone, carrying the inner peripharyngeal band forwards in front of it. The branchial sphincter is well developed (Pl. XXXIII. fig. 15), and a number of delicate radiating muscle bands start from its edge and run outwards and backwards over the

[1] Recherches sur le développement post-embryonnaire d'une Phallusie, *Archives de Biologie*, t. v. p. 611, 1884.

mantle. The nerve ganglion is conspicuous (Pl. XXXIII. fig. 15, *n.g.*) and is of irregularly rounded form. The aperture of the neural gland is distinct. In the specimen figured (Pl. XXXIII. fig. 15) it seemed to open posteriorly to the peripharyngeal band.

Family V. Diplosomidæ.

Colony forming a thin, incrusting layer, rarely thickened, never pedunculated.
Systems irregular, usually inconspicuous. Common cloacal apertures usually visible.
Ascidiozooids divided into two distinct regions, thorax and abdomen.
Test soft and gelatinous, usually transparent, rarely containing calcareous spicules. Vascular ectodermal appendages provided with muscle fibres.
Branchial Sac large, with four rows of stigmata.
Dorsal Lamina represented by large languets.
Alimentary Canal extending behind the branchial sac. Stomach smooth-walled.
Reproductive Organs behind the intestinal loop or on its right side. Testis forming more than one mass. Vas deferens not spirally coiled.
Gemmation pyloric. Larva gemmiparous.

The first known member of this remarkable family was *Diplosoma rayneri*, described by Dr. J. D. Macdonald in 1859[1] from a specimen obtained at Sydney, Australia. In the account of this new species and genus, Macdonald really gave the most essential characters of the family, but it was Giard who, in 1871,[2] first formally defined the Diplosomidæ. This latter author also added two new genera, *Pseudodidemnum* and *Astellium*, each containing a single species; and in 1883 von Drasche[3] described several additional species belonging to the family, and pointed out the characters and relations of the group more fully and correctly than had previously been done.

The family is evidently of small size, but seems to be widely spread in shallow water. It is more closely related to the Didemnidæ than to any other group of the Ascidiæ Compositæ. Jourdain[4] has recently proposed that these two families should be united under the name Oligosomidæ. This is quite unnecessary, as the two groups are sufficiently separated by the structure of the reproductive organs.

The colony in the Diplosomidæ forms a very delicate incrusting layer, usually attached slightly by the greater part of the lower surface, and easily removed. It never becomes massive, and is always sessile.

Both Giard and von Drasche describe the colony as formed of two thin layers of

[1] *Trans. Linn. Soc. Lond.*, vol. xxxii. p. 373. [2] Recherches sur les Synascidies, *Archives d. Zool. expér.*, p. 654.
[3] Die Synascidien, &c., p. 38.
[4] Sur les Ascidies Composées de la tribu des Diplosomidæ, *Comptes rendus*, t. c., No. 24, p. 1512.

test, an upper and a lower, between which the bodies of the Ascidiozooids are suspended, and they emphasize this peculiarity as one distinguishing these colonies from those of other Compound Ascidians; but in all the specimens of Diplosomidæ which I have examined, the relation between the test and the Ascidiozooids of the colony is essentially the same as that found in all other Ascidiæ Compositæ. The only difference is that the test is usually extremely soft and gelatinous, and that it is considerably broken up by the presence of numerous large spaces and canals which are prolongations of the common cloacal cavities, and serve to place the atrial apertures of the Ascidiozooids in communication with the exterior. This is of course a condition which is found to a greater or less degree in most Compound Ascidian colonies, and although the result of its considerable development in the Diplosomidæ is doubtless, as described by former authors, to reduce very greatly the amount of test in the centre of the colony, and leave only the surface layers as continuous and conspicuous expansions, still it is no novel arrangement, but merely a slight modification, and the test must be regarded as a true investing mass surrounding the Ascidiozooids on all sides, just as it does in the other Ascidiæ Compositæ.

The test is usually exceedingly transparent, but in some species it contains conspicuous pigment cells. Calcareous spicules are rarely present, and are confined to the superficial layer of the test. Giard was of opinion that they were never present, and made the absence of spicules the character by means of which he distinguished the Diplosomidæ from the Didemnidæ.[1] As a general rule, it is a good distinctive feature, but it will not hold good universally, as von Drasche has described two members of the Didemnidæ, *Didemnum inarmatum* and *Didemnum tortuosum*, in which the test has no calcareous spicules, and I have added a third species, *Didemnum inerme*, which is in the same condition; while, on the other hand, von Drasche found one of the Diplosomidæ, *Diplosoma pseudoleptoclinum*, in which calcareous spicules were present in the upper layer of the test, and in a small clump on each side of the thorax of the Ascidiozooids, and in one of the species to be described below, *Diplosomoides molle*, calcareous spicules are also present. Consequently, this character breaks down as an infallible diagnostic.

The general shape and structure of the Ascidiozooid is very much like that which prevails in the Didemnidæ. The thorax is usually longer than the abdomen, and the atrial aperture is very inconspicuous. The branchial sac is of large size, and the stigmata are well developed.

The stomach is ellipsoidal, and has no folds in its wall. Its long axis generally runs dorso-ventrally, and the intestine forms rather a wide loop.

The testis is usually in the form of two large spermatic vesicles, opening into a vas deferens which is not spirally coiled. This is an important point of distinction between

[1] Recherches sur les Synascidies, &c., p. 608. Jourdain, writing quite recently (*Comptes rendus*, June 15, 1885), has returned to this incorrect view that the absence of spicules is the chief distinguishing feature of the Diplosomidæ.

the present family and the Didemnidæ, where the vas deferens always commences by coiling spirally around the single large testis.

Pyloric gemmation, which is sometimes met with in the Didemnidæ, is found typically in the Diplosomidæ, where it produces in the Ascidiozooids the curious double-bodied appearance (see Pl. XLII. figs. 7, 8) first noticed by Macdonald in *Diplosoma rayneri*. Each new Ascidiozooid produced by gemmation in the colony is formed by the union of two distinct buds, which either arise independently from the body of the parent, or separate very soon after their origin, the one becoming the thorax and the other the abdomen. The first process of gemmation, however, is so early that it commences in the embryo. Consequently the larva produces at least two Ascidiozooids in place of one, but all the future Ascidiozooids of the colony have their bodies formed by two distinct buds [1] in place of by one, as in the case of other Ascidiæ Compositæ.

It has been shown conclusively by von Drasche that the three genera *Diplosoma*, *Pseudodidemnum*, and *Astellium* were distinguished by Giard upon quite insufficient grounds, so that the two latter names must be given up, leaving *Diplosoma*, Macdonald, as the only genus in the family. Jourdain [2] has recently changed Giard's *Astellium* into *Brevistellium*. Both names are unnecessary and must be abandoned. The suggestion made by von Drasche [3] that the species forming thicker colonies might with advantage be separated from those which produce mere incrusting films may possibly have to be carried out, but I believe that it is more practicable in the present state of our knowledge of the group to divide the family into two genera, in the one of which the test has no calcareous spicules, while in the other spicules are present, and I would propose the name *Diplosomoides* for the latter group, leaving *Diplosoma* for the more typical members of the family, with soft transparent colonies. The species of *Diplosomoides* are obviously more nearly allied to the Didemnidæ than are those of *Diplosoma*.

Diplosomoides, n. gen.

Colony usually thin and incrusting, sometimes only slightly attached.

Test gelatinous, sometimes firm externally, more or less opaque and of a whitish colour. Calcareous spicules present in the superficial layer.

The other characters of this genus are the same as those of the following one, *Diplosoma*, the single important distinguishing feature being the presence of spicules in the test. This, however, gives rise to opacity, and produces a whitish colour in the

[1] According to Jourdain, however (*Comptes rendus*, t. c., No. 24, p. 1512), the two buds arise as a single projection, from the œsophageal region of the body, which very soon divides into two parts.

[2] *Comptes rendus*, t. c., No. 24, p. 1512.

[3] Die Synascidien, p. 39.

upper layer of the test, while it causes the colony as a whole to become firmer and more solid looking.

In this genus I place von Drasche's *Diplosoma pseudoleptoclinum* from the Adriatic, and a new species described below, which was obtained during the Challenger Expedition off the Arrou Islands. These two species differ in a number of points, including the following:—In *Diplosomoides pseudoleptoclinum* the colony is thinner, more incrusting, and decidedly firmer, the spicules are more numerous, and there is a group of spicules placed on each side of the thorax. In *Diplosomoides molle*, on the other hand, the colony is thicker, very slightly attached, and very soft and flexible, the spicules are comparatively few, and there are none alongside the thorax. The branchial sac is also relatively larger than in *Diplosomoides pseudoleptoclinum*.

Diplosomoides molle, n. sp. (Pl. XLII. figs. 5–16).

The Colony is an irregularly rounded mass, attached slightly at various points. The surface is uneven but smooth. The colour is dull white with a greyish tinge.

The length is nearly 4 cm., and the breadth is 2·5 cm. The average thickness is about 5 mm.

The Ascidiozooids are fairly large and very numerous. They are distributed evenly all over the surface of the colony, and are closely placed. Several common cloacal apertures are present. The bodies of the Ascidiozooids are from 1·5 mm. to 2 mm. in antero-posterior length and about 0·5 mm. in greatest breadth. They are distinctly divided into two regions, thorax and abdomen.

The Test is exceedingly soft and flexible; it is easily torn. It is of a greyish-white colour externally, and of a clear hyaline grey internally, and is transparent. The matrix is clear and structureless. In the superficial layer of the colony it contains great numbers of small spherical or stellate calcareous spicules, while in the deeper parts of the test no spicules are present. Test cells are very abundant, they are mostly of small size and rounded form. No bladder cells are present. Vascular ectodermal appendages are frequently met with in the test.

The Mantle is thin and transparent. The chief muscle bands run longitudinally.

The Branchial Sac is large and well developed. There are four rows of fairly large stigmata, arranged with regularity. The transverse vessels are moderately wide, and are provided with muscle fibres, which are also continued into the longitudinal interstigmatic vessels.

The Dorsal Lamina is represented by a series of long narrow languets.

The Tentacles are well developed, and are arranged with regularity. There are sixteen, and they are of two sizes, placed alternately.

The Dorsal Tubercle has a narrow slit-like aperture running antero-posteriorly.

The Alimentary Canal is of large size, and forms a wide loop. The stomach is globular and smooth-walled.

Locality.—Off the Arrou Islands, September 18, 1874.

One specimen of this interesting species was obtained off the Arrou Islands, to the south-west of New Guinea, from shallow water. It is a moderately large colony, attached slightly by part of one edge to some gravel and shell fragments, and expanding upwards into an irregularly rounded and lobed form (Pl. XLII. fig. 5).

The specimen is a good deal creased and corrugated on the surface, but that is, I believe, to a large extent the result of preservation in alcohol; in all probability when it was living and all the Ascidiozooids in the colony had their branchial sacs expanded with water, it was larger and more rounded, and the surface was more regular than is shown in the figure. From its great softness the specimen is readily deformed, and it is probably now abnormally flat from having lain on one surface in a bottle for more than ten years.

The colour is the same dull white all over the surface. It is due mainly to the superficial layer of test containing spicules. The anterior ends of the Ascidiozooids show as small, rounded, more transparent dots on the surface. They are closely placed, and are equally numerous over the whole colony. The common cloacal apertures are not numerous, and they are not conspicuous. They are of slit-like form.

The test is gelatinous, and is perfectly clear and transparent in the interior of the colony. The outer layer, however, is slightly firmer, and is of a whiter colour and less transparent. It contains numerous small spicules, most of which are spherical, with or without numerous minute spines projecting from the surface. Some, however, are stellate, with many very delicate, sharp-pointed rays (Pl. XLII. fig. 12), and intermediate forms between the stellate and the spherical spicules occur. The calcareous spicules in this colony are absolutely confined to the superficial layer, and it is this which causes the difference between the surface layer of the test and the deeper parts. The test cells are especially abundant where there are no spicules.

The mantle allows the branchial sac and the other organs to be seen distinctly through it. There are two strong muscle bands which run longitudinally down the dorsal edge of the thorax. The branchial siphon is large. It is lined by a layer of test, in which calcareous spicules are found. These spicules are usually aggregated in three distinct clumps which lie just inside the sphincter. The margin of the aperture is not lobed. The branchial sphincter is moderately developed (Pl. XLII. fig. 13).

The superficial layer of test along with the Ascidiozooids may be stripped off from the rest of the colony (see Pl. XLII. fig. 6, which represents such a piece removed from the colony, and seen from the lower surface) as the deeper layers of test are very soft and easily torn, besides being much cut up by the cavities and passages by means of which the

atrial apertures of the various Ascidiozooids are placed in connection with the common cloacal apertures. There is, however, continuous test substance around the Ascidiozooids, and not merely a lower layer by which the colony is attached, and an upper layer from which the Ascidiozooids are suspended, as has been described in the case of some of the Diplosomidæ. It is really an investing mass, just like that of any other Compound Ascidian, except that it is much softer, and is more encroached upon by the common cloacal cavities and their prolongations.

The Ascidiozooids are very distinctly divided into thorax and abdomen, and these two regions are very much of the same size. The thorax is usually rather the longer, and the abdomen the broader of the two (see Pl. XLII. figs. 6, 7, 8, 9). The thorax and abdomen are connected by a very short and narrow pedicle, consisting mainly of the œsophagus and the rectum (Pl. XLII. fig. 9). The vascular ectodermal appendages given off by the Ascidiozooids are generally two in number, one longer and one shorter (Pl. XLII. figs. 8, 9). They run posteriorly through the test, and terminate in short wide swellings or bulbs (Pl. XLII. fig. 10), on which the ectoderm cells become columnar in form (Pl. XLII. fig. 11, shows a terminal bulb in optical section).

The branchial sac is longer than it is wide (Pl. XLII. fig. 8, *br.s.*). It has in most Ascidiozooids four rows of stigmata, and there are on an average ten stigmata in each row. The musculature of the branchial sac is well developed (Pl. XLII. fig. 14, *m.f.*). A strong band runs along each transverse vessel, and gives off fibres which pass upwards and downwards into the interstigmatic vessels. As the stigmata in adjacent rows usually alternate with each other, the same muscle fibres do not pass directly upwards from an interstigmatic vessel to one above, but always interlace with the muscle fibres in the transverse band, before passing to the next row (see Pl. XLII. fig. 14). The ciliated cells on the sides of the stigmata are distinct. In the branchial sacs of young Ascidiozooids the stigmata are much smaller, and are relatively shorter (Pl. XLII. fig. 15), while the transverse vessels are wider. Two Copepoda were found in the branchial sac of one of the Ascidiozooids examined.

The endostyle is of moderate size; its course is straight (Pl. XLII. fig. 8, *en.*). The dorsal languets are long and narrow, and are nearly tentacular in form. Their bases equal in breadth the space between the two dorsal muscle bands in the mantle (Pl. XLII. fig. 16, *d.l.*). In the young Ascidiozooid examined (see Pl. XLII. fig. 15, *l.*) the languets are relatively much shorter and stouter. They evidently become elongated as they grow older.

The tentacles (Pl. XLII. fig. 13, *tn.*, *tn'.*) are large and regular. The longer ones are as a rule about twice the size of the intermediate shorter tentacles. In some cases the dorsal, the ventral, and the two median lateral tentacles are rather larger than the four remaining long ones, thus producing three orders—four primary, four secondary, and eight tertiary—alternately placed.

The nerve ganglion and neural gland form an ellipsoidal opaque mass, placed in the mantle over the prebranchial zone. The aperture of the dorsal tubercle is immediately on the ventral face of this mass, and opens between the base of the dorsal tentacle and the anterior end of the dorsal lamina. It is a longitudinally placed slit with raised edges (Pl. XLII. fig. 13, *d.t.*). There is a very slight peritubercular area, but the tubercle really occupies nearly the entire breadth of the prebranchial zone. The region bounded by the peripharyngeal band (Pl. XLII. fig. 13, *p.p.*) is nearly as wide from side to side as it is dorso-ventrally.

The œsophagus commences at the dorsal edge of the posterior end of the branchial sac, and runs backwards to open into the large globular smooth-walled stomach (Pl. XLII. figs. 7, 8, 9, *st.*). The intestine, after leaving the posterior end of the stomach, curves round ventrally and then anteriorly in a wide open loop. It runs forwards to about the level of the œsophagus, and then turns dorsally at a sharp angle to become the rectum (Pl. XLII. figs. 7, 8, 9) which crosses the œsophagus and so reaches the dorsal edge of the branchial sac. The rectum contains dark-coloured fæcal pellets.

The reproductive organs were not well developed in any of the Ascidiozooids examined; but many of them showed buds in various stages of development (see Pl. XLII. figs. 7, 8). The method of budding is that first described by Macdonald, and since called pyloric budding by Giard. The thorax and the abdomen of the new Ascidiozooid arise as distinct buds[1] from the body of the parent (Pl. XLII. fig. 7, *br.s'.* and *st.*, *i'.*).

Diplosoma, Macdonald.

Didemnum, Milne-Edwards, Observations, &c., 1841.
Diplosoma, Macdonald, Trans. Linn. Soc. Lond., vol. xxxii. p. 373, 1858.
Diplosoma, *Pseudodidemnum*, and *Astellium*, Giard, Recherches, &c., 1871.
Pseudodidemnum, *Astellium*, Della Valle, Contribuzioni, &c., Napoli, 1877.
Diplosoma, von Drasche, Die Synascidien, 1883. In part.
Diplosoma, *Pseudodidemnum*, and *Brevistellium*, Jourdain, Comptes rendus, t. c. p. 1512, 1885.

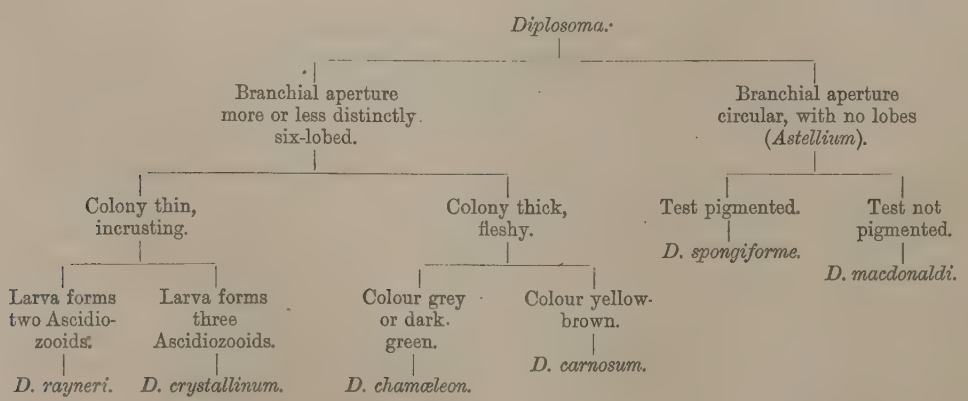
Colony usually thin and incrusting, rarely thick.
Systems irregular. Common cloacal apertures rounded.
Ascidiozooids divided into thorax and abdomen.
Test soft and gelatinous, usually transparent, sometimes pigmented, never with calcareous spicules.
Branchial Sac large, with four rows of stigmata.
Alimentary Canal moderately large. Stomach ellipsoidal and smooth-walled.
Reproductive Organs close to the intestinal loop. Vas deferens straight.
Gemmation pyloric. Larva gemmiparous.

[1] Possibly the two buds may have a common origin from the œsophageal region, such as Jourdain has described in the case of *Diplosoma* (*Brevistellium*) *spongiforme* (*Comptes rendus*, t. c., No. 24, p. 1512, 1885).

This genus contains the typical members of the family, with clear soft gelatinous colonies, like Macdonald's *Diplosoma rayneri* and Giard's *Pseudodidemnum crystallinum* but it also includes those species, like von Drasche's *Diplosoma carnosum*, where the colony becomes thick and fleshy; in none of them, however, are calcareous spicules ever developed in the test. The other characters are merely those of the family, which have already been sufficiently discussed.

In the living condition colonies of this genus are most beautiful objects, and on account of their wonderful transparency they allow a great deal of the anatomy of the Ascidiozooids to be made out without cutting into the test. The common cloacal apertures are also clearly visible in the living and expanded condition of the colony. They are circular apertures with very slight lobes or none at all, but often pigmented round the margin, and are placed on delicate conical processes from the surface of the colony. In spirit-specimens the common cloacal apertures are very rarely visible, and the limits of the irregular systems are difficult to determine.

Six species of *Diplosoma* are known with certainty. These are Macdonald's *Diplosoma rayneri*, Giard's *Pseudodidemnum crystallinum*, Giard's *Astellium spongiforme*, von Drasche's *Diplosoma chamæleon*, von Drasche's *Diplosoma carnosum*, and the new species *Diplosoma macdonaldi*. Milne-Edwards' *Didemnum gelatinosum* belongs to the genus, and may either be the same as *Pseudodidemnum crystallinum*, Giard, or a distinct species. Again, Della Valle's *Pseudodidemnum listerianum* may be *Diplosoma chamæleon* or a distinct species. Jourdain's *Pseudodidemnum zosterarum* has not yet been described; it may be merely a synonym. Leaving out these doubtful species, the genus may be divided as follows :—



Diplosoma macdonaldi, n. sp. (Pl. XLII. figs. 1–4).

The Colony is a thin spreading layer of irregular shape, slightly attached by parts of its lower surface. The upper surface is uneven but smooth. The colour is grey.

The length is about 2·5 cm., and the greatest breadth is 1 cm.; the thickness is about 1 mm.

The Ascidiozooids are moderately large and numerous. They are scattered irregularly over the surface of the colony, and are not arranged in definite systems. No common cloacal apertures are visible. The bodies of the Ascidiozooids are about 1·5 mm. in antero-posterior length and 0·5 mm. in greatest breadth; they are divided into two regions, thorax and abdomen.

The Test is very soft and flexible. It is of a clear grey colour and quite transparent. The matrix is slightly fibrillated in places, and contains large numbers of bladder cells and test cells of various kinds. No calcareous spicules are present. Many of the test cells are of large size (0·075 mm. in diameter) and of rounded form. They are coarsely granular.

The Mantle is rather thin and membranous. Its musculature is feeble.

The Branchial Sac is large. There are four rows of long stigmata. The transverse vessels are narrow, but they are provided with muscle fibres.

The Dorsal Lamina is represented by a series of long languets.

The Tentacles are of two sizes, placed alternately. They are about twelve in number.

The Alimentary Canal forms a wide loop. The stomach is large and smooth-walled.

Locality.—Off Bahia, Brazil, shallow water.

The small specimen for which this species is formed was found attached to a fragment of a Hydroid Zoophyte dredged in shallow water off Bahia. It is loosely attached to the branches of the Zoophyte around which it has grown (Pl. XLII. fig. 1). Its general colour is due to the Ascidiozooids, which are of an opaque grey and show distinctly, while the investing test is clear and almost colourless. The colony is exceedingly soft and flexible, and the outer layer of test may be readily stripped off, taking the Ascidiozooids with it, as in the case of the last species. Figure 2 on Plate XLII. represents such a preparation seen from the inner surface.

The Ascidiozooids lie at various angles to the surface, and are apparently quite irregularly placed. Their atrial apertures are connected by a system of canals and cavities which penetrate the test and greatly reduce its bulk and strength. These doubtless open at one or more points on the upper surface of the colony, but no such common cloacal apertures were discovered. The upper layer of test to which the Ascidiozooids adhere is fairly compact (Pl. XLII. fig. 2), but the lower parts are greatly vacuolated and contain

large numbers of bladder cells (Pl. XLII. fig. 3, *bl.*). In many places the bladder cells are polygonal from mutual pressure.

The test cells are of two distinct kinds: (1) the large granular cells, which are very conspicuous—these are mostly of spherical or ellipsoidal shapes, but occasionally become elongated; and (2) the ordinary small test cells, which are of fusiform, stellate, or branched shapes—these are not numerous, and are inconspicuous on account of their small size and clear protoplasm. Vascular ectodermal appendages are found here and there in the test. They have short wide terminal bulbs.

The thorax and abdomen of the Ascidiozooids are of nearly equal size, and they are not separated by a marked constriction as in the case of *Diplosomoides molle*. Some parts of the mantle are slightly pigmented, and of a brownish colour. The branchial siphon is very short, and the aperture is not lobed. The sphincter is, however, distinct. The muscle bands of the mantle are very delicate; they run in various directions. Two bands run along the dorsal edge of the thorax.

The branchial sac is longer antero-posteriorly than dorso-ventrally. The stigmata are regularly arranged, and their ciliated cells are distinct (Pl. XLII. fig. 4, *sg.*). The muscle bands in the transverse vessels are not strong, and there are no fibres present in the longitudinal interstigmatic vessels (Pl. XLII. fig. 4).

The endostyle is conspicuous; its course is straight. The dorsal languets are long and narrow. The tentacles are long; they vary a little in number, but are always of two sizes, and are arranged regularly. The nerve ganglion and neural gland form an ovate opaque mass placed not far from the branchial aperture.

The œsophagus leads backwards for a short distance from the branchial sac to the large globular smooth-walled stomach (Pl. XLII. fig. 2). The intestine curves round ventrally from the posterior end of the stomach in a wide open loop, and then crosses over to the dorsal side so as to reach the branchial sac close to the œsophagus. The intestine throughout the greater part of its length contains a series of round fæcal pellets of a brown colour (Pl. XLII. fig. 2). The stomach is also sometimes of a brown colour from the contained food matters.

The reproductive organs were not well developed in any of the Ascidiozooids examined.

Family VI. Cœlocormidæ, n. fam.

Colony massive, deeply concave on the upper surface, not attached.
Ascidiozooids large, scattered all over the surface. Branchial apertures five-lobed.
Test soft and gelatinous. Test cells numerous. Calcareous spicules present in the outer layer of the colony.
Branchial Sac large and well developed.
Dorsal Lamina represented by a series of languets.
Alimentary Canal extending beyond the branchial sac posteriorly, but not forming a distinct abdomen. Stomach smooth-walled.
Reproductive Organs hermaphrodite in the adult Ascidiozooid. Testis composed of a number of pyriform vesicles, which join a spirally coiled vas deferens.

The colony which will be described below under the name of *Cœlocormus huxley* is so remarkable in its structure, and differs so much from other Ascidiæ Compositæ, that I consider it necessary to form a new family for its reception. This family I would place, in a phylogenetic classification of the Tunicata, between *Didemnum* and *Pyrosoma*, so as to lie on the outskirts of the Ascidiæ Compositæ, leading in the direction of the Ascidiæ Salpiformes.

The colony in the only species known is massive, and is so deeply concave on the upper surface as to be cup-shaped or almost tubular (Pl. XXXVII. fig. 2, and Pl. XXXVIII. fig. 1). It is not attached, but was probably not free-swimming. There is only one common cloacal aperture in the single colony, and it is placed at the bottom of the central cavity (see fig. 10, B, p. 320). From this cloacal aperture canals spread through the test, and connect the atrial apertures of the various Ascidiozooids.

The branchial apertures are pentagonal or surrounded by five short lobes (Pl. XXXVIII. figs. 2, 3). They occur not only on the outer surface of the colony but also on the inner wall of the central cavity (fig. 10, B, p. 320).

In the shape of the colony, in its free condition, and in the form of the branchial apertures, this family differs from all previously described Compound Ascidians, while in the condition of the test, the branchial sac, the dorsal lamina, and the vas deferens, it agrees with the Didemnidæ. The presence of calcareous spicules in the test, and the spiral coiling of the vas deferens, especially indicate relationship to the Didemnidæ, but it is interesting to find that although the vas deferens has the same arrangement as in the family Didemnidæ the testis is quite different, and in place of forming one large ellipsoidal mass, it is divided into a number of distinct pyriform vesicles, as in the Distomidæ or the Polyclinidæ.

The family contains the single genus *Cœlocormus*.

Cœlocormus,[1] n. gen.

Colony massive but not attached; deeply concave on the upper surface, so as to contain a large central cavity.

Ascidiozooids large, not distinctly divided into regions; branchial aperture five-lobed.

Test soft and gelatinous. Test cells numerous and large. No bladder cells. Calcareous spicules present in the superficial layer.

Branchial Sac large. Stigmata very long and narrow.

Dorsal Lamina represented by a series of long triangular languets.

Tentacles well developed.

Alimentary Canal extending beyond the branchial sac posteriorly, but not forming a distinct abdomen. Stomach smooth-walled.

Reproductive Organs not large. Ovary only present in the adult Ascidiozooid. Testis formed of a number of spermatic vesicles. Vas deferens spirally coiled.

The essential characters and relationships of this very remarkable genus have been already discussed under the definition of the family. It contains the single species *Cœlocormus huxleyi*, which was obtained in the South Atlantic, off the east coast of Patagonia.

Cœlocormus huxleyi, n. sp. (Pl. XXXVII. figs. 1–8; Pl. XXXVIII. figs. 1–4).

The Colony has the form of a kidney-shaped mass, with a large internal cavity opening to the exterior at one end. It shows no sign of having been attached. The surface is fairly smooth. The colour is a light grey.

The length is 3·5 cm., the greatest breadth is 2 cm., and the thickness is 1·5 cm.

The Ascidiozooids are large and fairly numerous. They are distributed evenly over the whole surface of the colony, and are not arranged in any definite systems. No common cloacal apertures are visible externally. The body of the Ascidiozooid is placed vertically in the colony, and is not distinctly divided into regions. The branchial apertures are conspicuous.

The Test is soft and flexible. It is of a light grey colour and is semi-transparent throughout. The matrix is in the main clear and structureless, but contains a few long delicate fibres which traverse it in all directions. The test cells are large and numerous, but not conspicuous. No bladder cells are present. Calcareous spicules are present in the outer layer of the colony, but they are not very abundant. They are stellate and fairly regular, but vary in size and in the thickness of the rays and the sharpness of their points

[1] κοίλος and κορμός.

The Mantle is fairly strong. The muscle bands are delicate but regular.

The Branchial Sac is large and well developed. The stigmata are very long and narrow. The transverse vessels are comparatively slight.

The Dorsal Lamina is represented by a series of long triangular languets.

The Tentacles are long and thin. They are numerous and of two sizes, but are not regularly arranged.

The Dorsal Tubercle has rather a large aperture.

The Alimentary Canal is fairly large, but it does not extend far behind the branchial sac. The stomach is small and smooth-walled.

The Reproductive Organs are not conspicuous. The testis is composed of a number of pyriform vesicles which join a spirally coiled vas deferens. The tailed larvæ are very large.

Locality.—Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom temperature, 37°·2 F.; bottom, green sand.

One specimen of this interesting form was obtained from the considerable depth of 600 fathoms, off the east coast of South America. Seen from the side, the colony is distinctly reniform (Pl. XXXVII. fig. 1), having a convex upper and a concave lower surface and two rounded ends. An end view, however (Pl. XXXVII. fig. 2), shows that the mass is really hollow, being traversed throughout the greater part of its length by a large axial cavity which opens to the exterior by a terminal circular orifice about 7 mm. in diameter (Pl. XXXVII. fig. 2, and Pl. XXXVIII. fig. 1). Apparently the colony was not attached, but as there is a Polyzoon adhering to its outer surface, it was probably not free-swimming but lay on the sea-floor.

The extraordinary shape of the colony recalls the arrangement seen in *Pyrosoma*, where the Ascidiozooids and their investing mass form the walls of a hollow cylinder closed at one end. In *Pyrosoma*, however, while the branchial apertures of the Ascidiozooids open on the outer surface of the colony, the atrial apertures open on the inner surface into the axial cavity of the colony (see fig. 10, C), which is thus converted virtually into a common cloacal cavity, and the terminal aperture into the sole excretory orifice for the whole colony. In the present species this is not the case. The whole surface, both the outside of the specimen and also the lining of the axial cavity, is morphologically the outer surface of the colony, and the branchial apertures of the Ascidiozooids are found distributed all over it (see fig. 10, B). In this respect, therefore, *Cœlocormus huxleyi* presents an arrangement intermediate between that found in the typical Compound Ascidian (see fig. 10, A), where the colony is attached and more or less rounded, and the apertures of the Ascidiozooids open upon a flat or convex upper surface, and that peculiar to *Pyrosoma* (see fig. 10, C), where the colony is free-swimming, cylindrical, and has an axial cavity into which the atrial apertures of the

Ascidiozooids open independently. It is evident that although the form of the colony in the present species closely resembles that of *Pyrosoma*, still the inner surface lining the central cavity is homologous with part of the outer surface of the ordinary Compound Ascidian and not with the inner surface lining the central cavity of *Pyrosoma*. The present species is therefore to be regarded as an unattached Compound Ascidian, which shows, in the peculiar form of its colony, a transition to *Pyrosoma*.

The central cavity in *Cœlocormus huxleyi* divides about the middle of the colony into two branches which end cæcally and are separated from one another by a rounded eminence (see fig. 10, B, and Pl. XXXVIII. fig. 1) bearing on its summit a large irregularly rounded opening. This is the only common cloacal aperture visible in the specimen.

The Ascidiozooids are rather smaller and more numerous near the open end of the

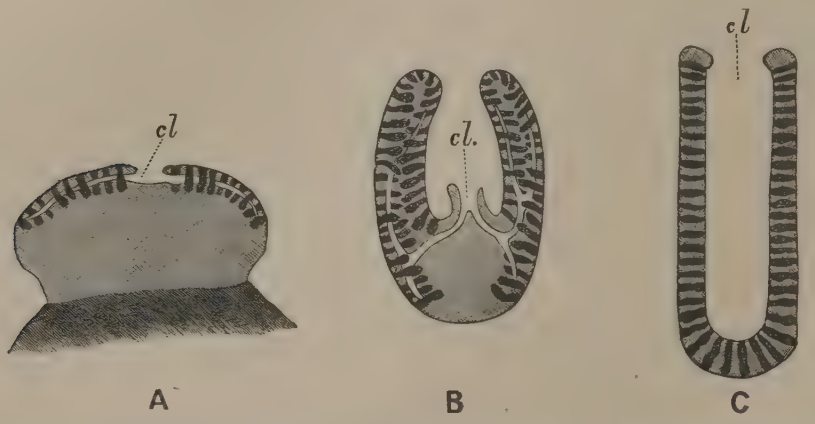


FIG. 10.—Diagrams showing the relations between—A, a typical Compound Ascidian; B, *Cœlocormus*; C, *Pyrosoma*. In all cases the colonies are represented in longitudinal section, and *cl.* indicates the opening of the common cloacal cavity.

colony than elsewhere. They are of large size and are fairly abundant about the centre, while at the closed end they are almost absent (Pl. XXXVII. figs. 1, 2), that part of the colony being mainly a mass of solid test in which some very large tailed larvæ are found imbedded. Probably the young Ascidiozooids are formed by gemmation at the open end, which is thus the growing point of the colony, and gradually move farther and farther away from the common cloaca, which may be regarded as the oldest part of the colony. The older and larger Ascidiozooids, as they approach the rounded closed end, probably die and are expelled from the colony, leaving behind them, imbedded in the test, the embryos or larvæ which they have produced during the later part of their existence. If this interpretation of the life-history of the colony is correct, the Ascidiozooids reproduce by gemmation during the early part of their existence, and sexually later on, when they are adult.

The branchial apertures are conspicuous over the greater part of the surface of the colony (Pl. XXXVII. fig. 1; Pl. XXXVIII. fig. 2). They are more regularly placed and more widely open on the inner walls of the cavity than on the outside. They are nearly circular in shape, and are surrounded by five short blunt lobes (Pl. XXXVIII. fig. 3), each of which is strengthened at its base by a clump of calcareous spicules, which forms a small opaque white dot visible to the eye (Pl. XXXVIII. figs. 2, 3).

The test is soft, and is to a great extent cut up by canals and spaces which are prolongations of the common cloacal cavity and serve to connect the atrial apertures of the various Ascidiozooids (shown diagrammatically in fig. 10, B, on p. 320). The clear matrix contains delicate fibres stretching in all directions. The test cells are large and granular; they are mostly rounded in form, but fusiform and branched shapes also occur. No spicules are present in the deeper parts of the test, and even in the superficial layers they are not very abundant. They are exactly like the spicules of a typical *Leptoclinum* (see Pl. XXXVII. fig. 4). The rays vary in thickness, but are generally very sharp at the points. No spherical forms were found.

In a section through the wall of the colony the large Ascidiozooids are seen projecting inwards from both surfaces, and occupying the greater part of the test (see Pl. XXXVII. fig. 3). The intestine, containing a row of fæcal pellets, is usually visible to the eye. It lies to a great extent alongside the branchial sac, and the thoracic and abdominal regions of the body are not distinctly separated.

The mantle is thin and transparent, but has a considerable number of muscle bands. They run mainly in a longitudinal direction, occasionally branching and anastomosing (Pl. XXXVII. fig. 5). The branchial sphincter is rather feeble. It is a narrow band of muscle, encircling the wide branchial aperture at the bases of the rounded lobes (see Pl. XXXVIII. fig. 3). The clumps of spicules which strengthen the lobes are usually placed on the line of the sphincter.

The branchial sac is large but delicate. The transverse vessels are narrow (Pl. XXXVII. fig. 6, *tr.*), and the stigmata are of great length but are arranged with regularity (Pl. XXXVII. figs. 6, 7). The ciliated cells are well developed (Pl. XXXVII. fig. 7).

The endostyle is not wide; its course is rather undulating. The dorsal languets are large. They taper to narrow points. The tentacles are very narrow, and the larger ones are of considerable length. They are closely placed round the base of the wide branchial siphon. The dorsal tubercle has a large ovate aperture immediately in front of the convoluted peripharyngeal band. The aperture leads into the usual infundibulum (Pl. XXXVIII. fig. 4, *inf.*), which rapidly tapers into a short narrow canal, leading to the neural gland (Pl. XXXVIII. fig. 4, *n.gl.*). This gland is an elongated curved body which lies along the ventral surface of the ellipsoidal nerve ganglion (Pl. XXXVIII. fig. 4, *ng.*).

The œsophagus runs posteriorly and ventrally from the branchial sac, and after a short course opens into the small, ovate, and smooth-walled stomach (Pl. XXXVII. fig. 8, *st.*). The stomach lies with its long axis dorso-ventrally. The intestine arises from its ventral end and soon turns anteriorly. It then curves round dorsally, and runs nearly parallel to the stomach and œsophagus (Pl. XXXVII. fig. 8, *i.*) until it reaches the dorsal edge of the body, where it terminates. The anus (Pl. XXXVII. fig. 8, *a*) is nearer to the posterior than to the anterior end of the body, a point in which this species agrees with *Pyrosoma* and differs from all ordinary Compound Ascidians. It is obvious that very slight change would be required to convert this alimentary canal into one agreeing with that of *Pyrosoma*, both in structure and course.

The intestine is occupied throughout the greater part of its length by a series of large dark coloured fæcal pellets, which are always a conspicuous feature (Pl. XXXVII. fig. 8). A system of branched tubules ramifies over the wall of the intestine in the middle part of its course. The various branches converge to a common duct, which leaves the wall of the intestine on its posterior edge opposite the stomach, and seems to open into the stomach, near its intestinal end.

The vas deferens is the most conspicuous part of the reproductive system. It consists of a coiled part, which forms several spiral turns, and a terminal straight portion. Several pyriform spermatic vesicles are united by very delicate ducts to the inner end of the spiral portion of the vas deferens. The ova are small and inconspicuous. They are absent in the younger Ascidiozooids, and seem to be formed late in life, and after the testes, so that there is here an approach to proterandry, a condition the reverse of that which I have found in most other Compound Ascidians. The ova form an elongated mass placed on the straight portion of the vas deferens.

No embryos were found in the Ascidiozooids examined, but some tailed larvæ of very large size are imbedded in the test near the closed end of the colony. They are of the ordinary shape, with an ellipsoidal body nearly 2 mm. in length, and a well-developed tail 4 mm. long. A single small pigmented sense-organ is present, and there are three large adhering papillæ at the anterior end of the body.

Family VII. Polystyelidæ, n. fam.

Colony massive or incrusting, sessile, rarely pedunculated, or formed of small masses connected by stolons. No common cloacal cavities present.

Ascidiozooids large, usually short-bodied, rarely with a distinct abdomen. Both apertures four-lobed, and opening directly to the exterior.

Test firm and cartilaginous. Matrix generally fibrillated, test cells small and inconspicuous, bladder cells rarely or never present. Vessels abundant, branched, and provided with distinct terminal bulbs.

Branchial Sac large and well developed. Folds sometimes present. Internal longitudinal bars strong, and fairly numerous.
Dorsal Lamina in the form of a plain membrane.
Tentacles numerous.
Alimentary Canal usually placed alongside the branchial sac, rarely extending beyond it posteriorly.
Reproductive Organs in the form of polycarps attached to or imbedded in the mantle, and projecting into the peribranchial cavity.
Gemmation effected by means of the vessels in the common test (?).

I form this family for a very interesting little group of Ascidians, the position of which is difficult to determine. I regard them as Compound Ascidians which are allied to the Cynthiidæ amongst Simple Ascidians, and have been evolved from the subfamily Styelinæ.[1] Various previously described forms must be placed here along with the new Challenger species. The history of the family is as follows :—

In 1850 Dr. Victor Carus, in a paper on the Zoology of the Scilly Isles,[2] described the genus *Thylacium*, which he considered as a Social Ascidian allied to *Clavelina*. The individual animals in his species, *Thylacium sylvani*, were connected by a common fleshy base from which they projected upwards, the body was divided into an abdomen and a thorax, and both apertures were four-lobed. Carus considered that in *Thylacium* reproduction was probably effected by gemmation as well as sexually, and he placed the *Cynthia aggregata* of Forbes and Hanley, which he also regarded as capable of reproducing by gemmation, in his new genus under the name of *Thylacium aggregatum*.

In 1863 Alder[3] gave a definition of *Thylacium*, Carus, and described two new species, *Thylacium normani*, which seems to be allied to the form described by Carus, and *Thylacium variegatum*, which differs from the other two in having the Ascidiozooids depressed and scarcely projecting from the surface of the colony. Alder does not specially mention the condition of the abdomen in this species, but I think from his general description of the body that the abdomen cannot be distinct from the thorax, and in that case this species ought not to remain in the genus *Thylacium*. I should be inclined then to remove Alder's *Thylacium variegatum* from the genus *Thylacium* and place it in Giard's genus *Synstyela*.

In 1868 Dr. J. E. Gray briefly described,[4] and figured in a woodcut, a new form which he regarded as a Social Ascidian and named *Oculinaria australis*. It was found at Fremantle in Western Australia, and formed an erect elongated colony composed of a massive test in which rounded Ascidiozooids were imbedded. The test contains imbedded sand-grains. There can be little doubt that *Oculinaria* belongs to this family, but whether it is

[1] See Summary and General Remarks at the end of this Report.
[2] *Proceedings of the Ashmolean Society*, vol. ii. p. 264, Oxford, 1843–52.
[3] *Ann. and Mag. Nat. Hist.*, ser. 3, vol. xi. p. 152.
[4] *Proc. Zool. Soc. Lond.*, vol. for 1868, p. 564.

distinct from the other known genera, and what its exact position is, cannot be determined without more information as to the structure than is given in Gray's short description.

In 1871 Dr. R. O. Cunningham, in his Report upon the collections made during the cruise of the "Nassau,"[1] described a remarkably large Ascidian from the Strait of Magellan under the name of *Goodsiria coccinea*. This species, which Cunningham regarded as a Social Ascidian, forms an elongated massive colony, sometimes more than 2 feet in length. The rounded Ascidiozooids are imbedded in the test, and are not divided into thorax and abdomen. I have examined the "Nassau" specimens in the British Museum, and the species was obtained again by the Challenger, consequently this form is well known to me. It is certainly distinct from the genus *Thylacium*, and it cannot be compared with the imperfectly known *Oculinaria*. *Goodsiria* may therefore be retained provisionally as a distinct genus, although it ought to be remembered that it may possibly be identical with *Oculinaria*, Gray.

Giard in 1874 described[2] two new genera of Ascidians from the French coast, *Polystyela* and *Synstyela*, which he regarded as being allied not to the Social Ascidians (Clavelinidæ), but to the Cynthiidæ and especially to the genus *Styela*. *Polystyela lemirri* is an incrusting species consisting of a common basal part above which the Ascidiozooids project to a height of from 4 to 6 mm. In this respect it agrees with the genus *Thylacium*, and Giard does not point out any differences between the two forms. As, however, Giard was acquainted with Carus's genus, the probability is that the two are distinct, and that *Polystyela* differs from *Thylacium* in having no distinct abdomen in the Ascidiozooids. Giard was of opinion that reproduction by gemmation was probably carried on, but he had not determined the matter conclusively. The second genus, *Synstyela*, is characterised by having the Ascidiozooids depressed and not projecting above the upper surface of the colony. Alder's *Thylacium variegatum* would therefore, as was suggested above, naturally find a place in this genus. Giard speaks of his species as being of a red colour, while Alder's *Thylacium variegatum* is shaded with flesh colour and red: possibly they may be the same species. If so, it should be called *Synstyela variegata* (Alder).

Heller,[3] writing in 1877, divided the family Cynthiidæ into two groups—the Monocynthiæ, including all the ordinary Cynthiidæ, and the Polycynthiæ, comprising the three genera *Thylacium*, *Polystyela*, and *Synstyela*. He therefore included these forms amongst the Simple Ascidians. Since that date no further attempt has been made to classify this curious little group of Ascidians.

There can be no doubt that the family Polystyelidæ is allied to the Styelinæ amongst Simple Ascidians, and especially to the genus *Polycarpa*, Heller. The condition of the test in some forms, the shape of the Ascidiozooid in others, and the structure of the

[1] *Trans. Linn. Soc. Lond.*, vol. xxvii. p. 465. [2] *Assoc. franç.*, Lille, 1874, p. 432.
[3] Untersuchungen über die Tunicaten des Adriatischen und Mittelmeeres, Abth. 3, Wien.

branchial sac in all, and still more the condition of the reproductive organs, show such a close resemblance to the corresponding parts in species of *Polycarpa* and *Styela*, that the two groups must be closely related, as was supposed by Giard and by Heller. But still it is impossible to regard the Polystyelidæ as Simple Ascidians. *Thylacium*, *Oculinaria*, and *Goodsiria* were all originally described as Social Ascidians allied to *Clavelina*, which produces buds. Carus and Giard both came to the conclusion that reproduction by gemmation probably took place in the genera they described, and although, like them, I have not been able to settle the matter conclusively, I think there can be very little doubt that the specimens I have examined are true colonies produced by a process of gemmation from the vascular appendages of a single Ascidiozooid.

It is well known that some species of the Styelinæ (*e.g.*, *Styela grossularia*) under certain circumstances produce aggregations which have a superficial resemblance to colonies. When individuals are closely crowded together their tests unite to form a continuous mass, and young individuals of the same species attach themselves to the tests of the older specimens. These aggregations, however, are not colonies. There is no reproduction by gemmation, the individuals in the mass have all been produced from ova, and have no relation to one another except as near neighbours, and finally they are imbedded in a common test or investing mass.

The specimens of the Polystyelidæ in the Challenger collection are not mere aggregations of individuals, they are colonies of Ascidiozooids imbedded in a common test which is penetrated by a system of vessels—consequently they must be regarded as Compound Ascidians. They are not, however, closely allied to most of the other Compound Ascidians, but have, I am inclined to believe, been evolved separately from the Simple Ascidians, and not from the end of that group occupied by *Clavelina* and *Ecteinascidia*, to which some of the Compound Ascidians are closely allied,[1] but from near the genus *Polycarpa* amongst the Cynthiidæ. The only other family of Compound Ascidians to which the Polystyelidæ seem to be closely allied is the Botryllidæ. The general shape of the Ascidiozooids, the appearance and course of the alimentary canal, and the structure of the branchial sac, are so similar in the two families, that I believe the Botryllidæ to be more nearly related to the Polystyelidæ than they are to the rest of the Compound Ascidians.

The chief characteristics of the Polystyelidæ are the large and usually rounded Ascidiozooids, with their four-lobed apertures, and the total absence of common cloacal cavities, the possession of branching vessels like those of the Botryllidæ in the test, the presence of numerous strong internal longitudinal bars, and sometimes of folds, in the branchial sac, and the simple condition of the dorsal lamina.

The shape of the colony varies greatly. It is massive and pedunculated in *Goodsiria placenta*, massive and sessile in *Goodsiria coccinea*, incrusting in *Synstyela incrustans*, and broken up into small pieces united by irregular stolons in *Chorizocormus*.

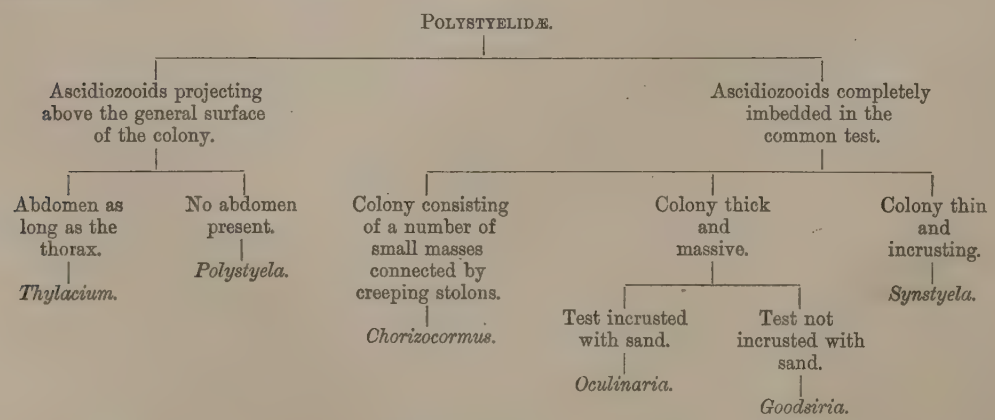
[1] See Summary and General Remarks at the end of this Report.

A distinct abdomen is present in the Ascidiozooid only in the genus *Thylacium*, Carus, so far as is known. In all other members of the family the alimentary canal lies alongside the branchial sac as it does in the Botryllidæ and in most of the Simple Ascidians. In some cases (*e.g.*, *Synstyela incrustans*) the test may be prolonged beyond the Ascidiozooids to form a spreading margin to the colony, in which numerous vessels ramify and terminate in dilated bulbs. It is probably in connection with these terminal bulbs that young Ascidiozooids are formed.

The branchial sac is always large. When longitudinal folds are present (*e.g.*, *Goodsiria placenta*) they are in the rudimentary condition[1] so frequently found amongst the Styelinæ. In some cases (*e.g.*, *Goodsiria coccinea*) there are no folds in the branchial sac. Dorsal languets are never present in the family.

The reproductive organs are present on both sides of the body in the form of little "polycarps" or masses of ovaria and spermaria partly imbedded in the mantle, and projecting into the peribranchial cavity just as in the species of *Polycarpa*. The curious "endocarps" of unknown function, which have previously only been known from the Styelinæ, are also present on the mantle of some if not all species of the Polystyelidæ (*e.g.*, *Synstyela incrustans*, see Pl. XLVI. fig. 14). In some cases the polycarps are hermaphrodite (*e.g.*, *Goodsiria placenta*), as they are in the Simple Ascidians, while in other cases they are unisexual (*e.g.*, *Goodsiria pedunculata* and *Synstyela incrustans*, Pl. XLVI. figs. 12, 13), and the male and female polycarps differ somewhat in appearance.

The genera[2] which belong to this family may be distinguished by the following characters :—



[1] See Herdman, On Individual Variation in Simple Ascidians, *Trans. Lit. and Phil. Soc. of Liverpool*, vol. for 1882.

[2] It is possible that the genus *Pyura*, founded by Blainville for an animal discovered by Molina (Saggio sulla Storia naturale del Chili, 1782), and since found by Cunningham (Notes on the Natural History of the Strait of Magellan, Edinburgh, 1871, p. 430) on the shores of the Bay of Arauco, and described as being a "Social Ascidian," belongs to this family. But the little that is known of its structure is not sufficient to determine its position with any certainty.

These are all old genera with the exception of *Chorizocormus*, which is formed for the reception of a new species collected by the Challenger Expedition at Kerguelen Island. It is allied to *Synstyela*, but differs from that genus in having the colony broken up into a number of distinct pieces united by stolons, in place of forming a continuous incrusting layer.

The Challenger Polystyelidæ represent three out of the six genera in the above table, viz., *Goodsiria*, Cunningham, *Synstyela*, Giard, and *Chorizocormus*, Herdman. There are five species, four of which are new to science, in the collection.

Goodsiria, Cunningham.

Goodsiria, Cunningham, Trans. Linn. Soc. Lond., vol. xxvii. p. 465, 1871.

Colony massive, sessile or pedunculated, not incrusted with sand.

Ascidiozooids large and ovate in shape, completely imbedded in the common test; not divided into thorax and abdomen. Apertures four-lobed, both on the anterior end.

Test solid, cartilaginous, not sandy. Matrix delicately fibrillated. Vessels present.

Branchial Sac well developed; folds present, rudimentary, or absent; internal longitudinal bars always present.

Dorsal Lamina in the form of a plain membrane.

Alimentary Canal not prolonged behind the branchial sac. Stomach folded longitudinally.

Reproductive Organs in the form of polycarps.

This genus was founded by R. O. Cunningham in 1871 for a large species, *Goodsiria coccinea*, which was obtained in the Strait of Magellan and at the Falkland Islands during the cruise of the "Nassau" between 1866 and 1869. Cunningham's description[1] refers only to the external characters, so I have supplemented it by the necessary details of the internal structure.

The colonies of this genus form large masses which may be disc-shaped, pyriform, or elongated. They are sometimes sessile (*Goodsiria coccinea*), and in other cases shortly pedunculated (*Goodsiria placenta*), while in one of the specimens of *Goodsiria pedunculata* a very long peduncle is present. The area of attachment is always small.

Cunningham has figured the short-bodied ovate or flask-shaped Ascidiozooids with the alimentary viscera placed alongside the branchial sac, a character which distinguishes this genus from *Thylacium*, Carus. The Ascidiozooids are completely imbedded in the test, which forms a thick solid mass. Bladder cells are never present in the test, and the usual test cells are small and inconspicuous. The vessels branch and terminate in dilated bulbs.

[1] *Trans. Linn. Soc. Lond.*, vol. xxvii. p. 465.

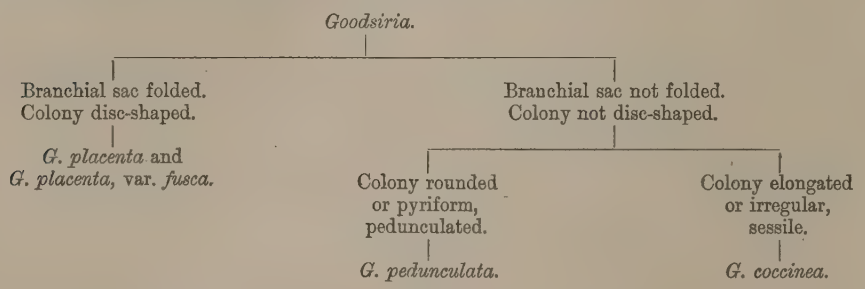
The mantle is fairly muscular, and is in some cases pigmented. Transverse, longitudinal, and oblique muscle bands are usually present.

The branchial sac is large and well developed. Longitudinal folds are present in *Goodsiria placenta*, in some cases rudimentary in *Goodsiria placenta*, var. *fusca*, and altogether absent in *Goodsiria pedunculata* and *Goodsiria coccinea*. These folds are singularly like those of some of the Styelinæ amongst the Ascidiæ Simplices.

The internal longitudinal bars of the branchial sac are always strong and conspicuous in the genus, but the transverse vessels and the stigmata vary very considerably in size in the different species. The tentacles are always numerous and well developed. Languets are never present on the dorsal lamina.

The polycarps may project freely from the mantle or be deeply buried in its substance. They are hermaphrodite in *Goodsiria placenta* and *Goodsiria coccinea*, and unisexual in *Goodsiria pedunculata*. Young Ascidiozooids are probably produced in the dilated ends of the vessels in the test, but I have not been able to find any buds.

The genus may be divided in the following manner :—



Goodsiria coccinea is an old species, the others are new to science. This genus has only been found off the southern ends of Africa and South America.

Goodsiria placenta, n. sp. (Pl. XLIII. figs. 1–10 ; Pl. XLIV. figs. 4, 8–10).

The Colony is a large discoid mass attached by a short peduncle which projects from one edge. It is rudely circular in outline. The edge opposite to the peduncle is the thinner. The two sides are nearly equally flattened. The surface is not quite even and is slightly roughened. The colour is a pale grey with a slightly pinkish tint in some places. The peduncle is dark brown.

The total length is about 7 cm., the breadth is about 8 cm., the thickness is from 2 to 3 cm., and the length of the stalk is from 2 to 3 cm.

The Ascidiozooids are large and fairly numerous. They are evenly distributed over the surface of the colony, where their anterior ends show as slightly darker areas of

circular or elliptical form marked by the distinct branchial and atrial apertures. Both apertures are more or less distinctly four-lobed. The bodies of the Ascidiozooids are slightly elongated antero-posteriorly, and are about 6 or 7 mm. in length. They are placed vertically in the colony, and are not divided into regions.

The Test is firm and cartilaginous. In sections it is whitish-grey with a slight hyaline tint, and is semi-transparent. The outer layer is much firmer and tougher and more opaque than the rest. The matrix is seen, when highly magnified, to be delicately fibrillated. No bladder cells are present. Vessels are well developed in the test, and especially in the peduncle. The vessels branch and anastomose freely, and terminate in ovate or irregular swollen bulbs.

The Mantle is moderately strong. The muscle bands are delicate but numerous; they run in all directions.

The Branchial Sac is large and well developed. There are three folds upon each side. Each fold has about four internal longitudinal bars upon each side, and there are two bars in the interspace. The meshes are elongated transversely, and contain each about three stigmata. The transverse vessels are very wide, and are all of about the same size. The stigmata are short and wide. Muscle fibres are present in some cases; they are usually in the transverse vessels.

The Endostyle is large and conspicuous. Its course is straight.

The Dorsal Lamina is a plain membrane with well marked ribs corresponding to the transverse vessels of the branchial sac, but with no marginal teeth or processes.

The Tentacles are numerous and closely placed. There are about fifty, and they are of two sizes placed alternately.

The Dorsal Tubercle is small and inconspicuous. It is placed on the ventral surface of the large dark neural gland.

The Alimentary Canal is placed alongside the branchial sac. It is directed transversely. The stomach is ovate and has its wall longitudinally folded. The intestine is narrow, and forms a moderately wide loop.

The Reproductive Organs are in the form of polycarps imbedded in the mantle, and projecting into the peribranchial cavity. Each polycarp is hermaphrodite. The ducts terminate on a prominent papilla.

Locality.—Simon's Bay, Cape of Good Hope; depth, 10 to 20 fathoms.

Two large specimens of this interesting species were dredged in Simon's Bay at the South end of Africa, from a depth of 10 to 20 fathoms. They are irregularly discoid masses, which were probably attached in a vertical position, the short peduncle being a

projection from one edge of the disc (Pl. XLIII. fig. 1). The exact dimensions of the two colonies are as follows :—

	A.	B.
Length,	6·5 cm.	7·0 cm.
Breadth,	7·3 „	8·5 „
Thickness,	3·0 „	2·0 „
Length of peduncle,	2·0 „	3·0 „
Average thickness of peduncle,	1·0 „	1·5 „

The thickness gradually diminishes from the point where the stalk is attached to the opposite end, which was probably the upper edge of the colony. The peduncle rapidly tapers downwards from the point where it joins the disc to a small irregularly shaped area of attachment (Pl. XLIII. fig. 1). The colour is on the whole a pale slate-grey. The anterior ends of the Ascidiozooids have more of a dull bluish tint, and the investing mass between them is whiter. The peduncle is of an earthy brown colour, and is strongly wrinkled transversely (Pl. XLIII. fig. 1).

The Ascidiozooids are conspicuous externally over the greater part of the surface. The rounded areas visible vary from 1 to 6 mm. in length; the general size is 4 mm. As a rule they are larger at the lower edge of the colony near the peduncle, and smaller at the opposite end (Pl. XLIII. fig. 1). This is exactly what would be expected if the young Ascidiozooids were formed at the upper free end of the colony, and is the reverse of the condition found in *Colella*, amongst the Distomidæ, where the new Ascidiozooids are added to the base of the colony.

In some places the apertures are distinctly four-lobed, in others they are circular, and sometimes they appear irregular; when they are widely open they are always circular in outline. In an Ascidiozooid which appears on the surface as 4 mm. in diameter, the apertures are about 2 mm. apart (Pl. XLIII. fig. 1).

A section through the colony (Pl. XLIII. fig. 2) shows that the Ascidiozooids occupy only an outer zone which takes up about one-third of the thickness, leaving a central region formed of test only. The Ascidiozooids are of rounded or ellipsoidal form, and vary considerably in antero-posterior length; all sizes from 4 to 8 mm. are common (Pl. XLIII. fig. 2). The body is nearly equally wide throughout its length, and there is no division into thorax and abdomen.

The test is solid and massive; in the interior of the colony, although firm, it is not at all hard; it has an elastic feeling, and is moderately tough. The minute fibrillation extends through the test matrix in all directions. The test cells are small and not numerous. They are mostly of rounded forms. The vessels are a conspicuous feature in sections of the test. They are mostly of small calibre, but they branch frequently (Pl. XLIII. fig. 3) and their terminal swollen bulbs are large.

The musculature of the mantle is moderately strong. The numerous fine muscle bands form a close network (Pl. XLIV. fig. 9, *m.*). The sphincters are well developed,

and large numbers of delicate muscle bands radiate from the two siphons (Pl. XLIII. fig. 10, *m.*).

The branchial sac is thin-walled. The stigmata are short, and in some places, especially near the dorsal edge (see Pl. XLIII. fig. 4), are reduced almost to rounded openings. The folds are narrow, but well marked (Pl. XLIII. fig. 4, *br.f.*). They are exactly like those of many species of the Styelinæ amongst Simple Ascidians. The internal longitudinal bars are regular, but have no papillæ. The transverse vessels vary somewhat in width, but the sizes are not arranged with regularity. In some places slight horizontal membranes are present for short distances. They are best seen alongside the dorsal lamina (Pl. XLIII. fig. 4, *tr.*).

There is a good deal of irregularity in some of the branchial sacs. In some places several small stigmata occur between two adjacent transverse vessels, and occasionally monstrous stigmata are seen which have been formed by the junction of several ordinary stigmata (Pl. XLIII. fig. 4). The meshes are fairly regular in size, and there are three rows in each of the ordinary interspaces. Between the first fold on each side and the dorsal lamina there are only two rows of meshes, one of the usual size, and the other, next the dorsal lamina, twice the ordinary size and containing about six stigmata (Pl. XLIII. fig. 4). Next to the endostyle a row of meshes of the usual size occurs.

The dorsal lamina (Pl. XLIII. fig. 4, *d.l.*) is narrow and has a smooth edge. The ribs on its sides are continuous with the horizontal membranes of the transverse vessels.

The tentacles alternate in size with regularity. They are so closely placed that their bases touch (Pl. XLIII. fig. 10, *tn*, *tn'*). At the base of the atrial siphon, where the invaginated layer of test ends, there is a slight ridge which bears a series of small tentacles projecting freely into the peribranchial cavity (Pl. XLIII. fig. 10, *at.tn.*). These atrial tentacles are much smaller than the ordinary or branchial tentacles, and there are only twelve of them. The position of the atrial tentacles in relation to the atrial siphon corresponds exactly to the position of the branchial tentacles at the base of the branchial siphon, but their use at the entrance to the peribranchial cavity is not obvious. It has been observed in some Simple Ascidians that the current of water which usually flows in at the branchial aperture and out at the atrial is occasionally reversed for a short period, the atrial aperture becoming inhalent. Possibly in the present species this habit may have become so marked as to have favoured the development of a circle of atrial tentacles which would act as tactile organs waving in the current of water entering the animal. In one of the new Simple Ascidians (*Bathyoncus mirabilis*) obtained during the Challenger Expedition, there are two circles of small atrial tentacles developed.[1] These resemble the atrial tentacles of the present species in size and shape.

The nerve ganglion and neural gland together form an elongated ellipsoidal mass,

[1] See this Report, Part I. (in vol. vi., 1882), p. 167, pl. xxiv. fig. 12.

stretching from the base of the branchial tentacles more than half-way to the base of the atrial siphon (Pl. XLIII. fig. 10, *n.g.*). The peripharyngeal band is regular. It forms a slight peritubercular area on the dorsal edge.

The layer of test lining the atrial siphon is thrown into a series of corrugated ridges, about twelve in number, and leading downwards from the edge of the obscurely four-lobed aperture to the circle of atrial tentacles (Pl. XLIII. fig. 10, *at.*).

The œsophageal aperture is placed far back on the dorsal edge of the branchial sac. The œsophagus is a short curved tube which turns ventrally and leads into the narrow dorsal edge of the stomach (Pl. XLIII. fig. 6, *œ, st.*). The long axis of the stomach lies dorso-ventrally. On its anterior wall, near the intestinal end, there is a short cæcum (Pl. XLIII. fig. 8, *ves.*) which receives two ducts, one coming from each side of the intestine, where they branch into a large number of delicate tubules. The intestine on leaving the ventral edge of the stomach runs ventrally for a short distance and then turns anteriorly and dorsally in a wide curve. It runs parallel to the stomach and œsophagus till it reaches the dorsal edge of the body, and then turns sharply forwards to become the rectum (Pl. XLIII. fig. 6, *r.*), which runs for a short distance anteriorly along the dorsal edge of the branchial sac and ends in an anus with a slightly thickened border (Pl. XLIII. fig. 6, *a.*). Figure 5 represents on a smaller scale the alimentary canal of an Ascidiozooid where the axis of the stomach and of the middle portion of the intestine were not dorso-ventral in direction (their usual condition), but were inclined ventrally and posteriorly (compare figs. 5 and 6 on Pl. XLIII.).

The longitudinal folds on the stomach are regular and closely placed. They are from fifteen to twenty in number. A typhlosole is present in the intestine. The system of glandular tubules on the intestine is well developed (Pl. XLIII. figs. 7, 8, *h.t.*), and extends up the rectum to the anus. The tubules branch freely, and their ends form ovate dilated bulbs. They join to form a large duct on each side of the middle portion of the intestine, and these ducts open into the rounded projection on the anterior edge of the stomach (Pl. XLIII. fig. 8, *ves.*). The posterior edge of the stomach-wall is connected with the mantle externally by a large blood-vessel (Pl. XLIII. fig. 6).

The reproductive organs are imbedded in the mantle (Pl. XLIV. figs. 4, 8, 9), and form thickenings projecting into the peribranchial cavity, which may be compared with the polycarps of the genus *Polycarpa* amongst Simple Ascidians. Some of the polycarps are much more convex than others (compare figs. 8 and 9 on Pl. XLIV.).

The ova are few in number, and are generally placed near the centre of the polycarp (Pl. XLIV. fig. 8, *o*). The oviduct is a very wide slit, which usually appears curved in a crescentic manner in sections (Pl. XLIV. fig. 8, *o.d.*).

The spermatic vesicles are numerous, and are placed on all sides of the ovary (Pl. XLIV. fig. 8). They are pyriform vesicles (Pl. XLIV. fig. 10, *t.v.*) with delicate ducts, which join in twos and threes to form larger tubes which finally unite into one

duct on each side of the polycarp (Pl. XLIV. figs. 8, 9). The two ducts eventually unite into a single vas deferens which terminates on a prominent papilla projecting from the surface of the polycarp into the peribranchial cavity (Pl. XLIV. fig. 4, *v.d.*). The walls of the spermatic vesicles and their ducts are formed of distinct cubical epithelium, while the interior is occupied by small rounded cells and spermatozoa (Pl. XLIV. fig. 10, *t.v.*).

Figure 8 on Plate XLIV. represents a transverse section through a polycarp, showing the spermatic vesicles arranged symmetrically on the two sides of the ova and oviduct, while figure 4 represents a longitudinal section on one side of the middle line, showing the male system only. Figure 9 is an oblique section, and exhibits spermatic vesicles and their ducts cut at all angles. This last figure shows the position of the polycarp relatively to the superjacent mantle (*m.*) and test (*t.*).

A large number of tailed larvæ and some embryos were found in the peribranchial cavities of the Ascidiozooids. They lie mainly on the right side of the peribranchial cavity, and near the ventral edge. The fully formed tailed larva has an arrow-shaped body with a blunt anterior end (Pl. XLIII. fig. 9), and measures about 1 mm. in length, The tail is about 2·5 mm. in length and has a wide membranous fringe.

Goodsiria placenta, var. *fusca*, nov. (Pl. XLIV. figs. 5–7).

Two large colonies, dredged in Simon's Bay, Cape of Good Hope, from a depth of 10 to 20 fathoms, resemble *Goodsiria placenta* in general appearance, but differ in a number of details. Consequently I have thought it best to regard them as forming a variety of that species until further observations have been made upon the range of variability in the group, and upon the colours of the colonies in the living condition.

Both specimens are larger than the colonies of *Goodsiria placenta*, and although of the same general shape as that species, differ slightly in their proportions, being elongated transversely, so as to be more ovate than discoid (Pl. XLIV. fig. 5). They are also rather thinner, and their surfaces are flatter. The dimensions of the colonies are as follows:—

	A.	B.
Length, ...	9·0 cm.	8·0 cm.
Breadth, ...	12·0 „	11·5 „
Length of peduncle, ...	...	2·5 „

The colour of these specimens is very decidedly darker than in *Goodsiria placenta*, and the Ascidiozooids seen externally seem to be rather smaller and more numerous (see Pl. XLIV. fig. 5, and Pl. XLIII. fig. 1). The peduncle is relatively rather shorter; in one of the colonies it is absent.

The test is very much the same as that of *Goodsiria placenta*, but the mantle differs considerably in appearance and structure. It is thicker and more opaque than the

mantle of *Goodsiria placenta*, and the muscle bands are rather stronger and more regularly arranged (Pl. XLIV. fig. 7, *m.*). Most of them run longitudinally and transversely. The mantle is considerably pigmented; large patches of opaque white pigment corpuscles occurring every here and there.

The branchial sac is large and thin-walled, but differs from that of *Goodsiria placenta* in having the folds slight and the stigmata very small. There are three folds on each side of the sac, but they are very irregularly developed, being sometimes of fair size (Pl. XLIV. fig. 6, *br.f.*), while at other times they are quite rudimentary, and are represented merely by areas where a few of the internal longitudinal bars are unusually closely placed (Pl. XLIV. fig. 6, *br.f'.*). This condition recalls what is seen in *Styela grossularia* and some other members of the Styelinæ amongst Simple Ascidians. There may be from six to two internal longitudinal bars on a fold. There are usually three or four internal longitudinal bars in each interspace, in place of two as in *Goodsiria placenta*. Horizontal membranes are either absent or very slightly developed on the wide and irregular transverse vessels. The stigmata are numerous but very small (Pl. XLIV. fig. 6, *sg.*). They are rather irregularly arranged, the rows being frequently inclined, and occasionally splitting up into two rows or uniting again as new transverse vessels form or as two neighbouring vessels join (see Pl. XLIV. fig. 6). The ciliated cells are rather small, and their free ends do not project. There are a few muscle fibres developed in the vessels of the branchial sac, chiefly in the transverse vessels.

The endostyle is large and conspicuous. Its course is straight. The dorsal lamina has a plain edge, and the ribs are not so distinctly marked as in *Goodsiria placenta*.

The alimentary canal is fairly large. The œsophagus is short but wide; it curves posteriorly and then ventrally to enter the stomach. The stomach is nearly globular in shape. It is directed dorso-ventrally. Its wall is thick and is thrown into a large number of longitudinal folds. There are usually about twenty well-marked folds; they are strongly developed about the middle of the stomach and die away towards the œsophageal and intestinal ends. The intestine leaves the ventral end of the stomach, and almost at once turns anteriorly and then dorsally. It curves round the anterior edge of the stomach, forming rather a narrow loop, and then, opposite the œsophagus, it turns sharply forwards to become the rectum, which runs anteriorly for a short distance along the dorsal edge of the branchial sac. The intestine is rather wider than that of *Goodsiria placenta*, and the typhlosolè in its interior is thrown into a series of convolutions which are visible through the comparatively thin walls of the intestine. The rectum is narrower than any other part of the alimentary canal. The system of branched tubules with dilated terminal bulbs is exceedingly well developed all over the walls of the intestine, and it communicates with the anterior edge of the stomach by the usual duct and vesicle. The vesicle on the wall of the stomach where the duct opens is apparently not so well developed as in *Goodsiria placenta*.

The reproductive organs form large masses attached to the inner surface of the mantle and projecting into the peribranchial cavity. These polycarps are larger than those of *Goodsiria placenta*, but are similar in other respects.

Several very large tailed larvæ were found in the peribranchial cavity of one of the Ascidiozooids examined.

The examination of further specimens of this form may possibly show that it ought to be regarded as a distinct species from *Goodsiria placenta*, but I am inclined to expect that intermediate forms will be found showing that both are members of a single variable species.

Goodsiria pedunculata, n. sp. (Pl. XLIV. figs. 1–3).

The Colony has the form of a rounded or pyriform mass supported on a peduncle. The upper end is wide and convex. The surface is uneven and not smooth. The colour is light grey.

The length is 4·5 cm., the breadth is nearly 3 cm., and the thickness is about 2·5 cm.

The Ascidiozooids are large and fairly numerous. They are distributed evenly over the surface of the colony. Their anterior ends show as rounded or elliptical areas of a slightly darker colour, usually from 2 mm. to 3 mm. in length. Each is provided with two apertures, which are prominent and conspicuous. The bodies of the Ascidiozooids are slightly elongated antero-posteriorly, but are not divided into regions.

The Test is firm and cartilaginous, and the outer layer is rather tougher than the rest. The internal part is white in sections, and is rather opaque. The matrix is apparently structureless, but test cells are abundant. There are no bladder cells. The test cells are not large; they are mostly of rounded and fusiform shapes, and are generally pigmented, of a yellowish-brown colour. Vessels are not numerous in the test.

The Mantle is moderately strong, and the musculature is well developed. The muscle bands run in all directions.

The Branchial Sac is large and rather delicate. No folds are present, but the internal longitudinal bars are well developed. They are regularly arranged and have no papillæ. The transverse vessels are moderately wide, and are all of about the same size. The stigmata are elliptical in shape and are of fair size. They are arranged with great regularity. The meshes are slightly elongated transversely, and each contains three stigmata.

The Endostyle is large and conspicuous. Its course is straight.

The Dorsal Lamina is a plain membrane.

The Tentacles are numerous, and are all of the same size.

The Alimentary Canal lies alongside the branchial sac. The stomach is globular and has its wall folded. The intestine is rather narrow.

The Reproductive Organs are in the form of polycarps, which are, however, unisexual.

Locality.—Station 315, January 26, 1876; lat. 51° 40′ S., long. 57° 50′ W.; depth, 5 to 12 fathoms; bottom, sand and gravel.

I place in this species two somewhat dissimilar colonies which were obtained off the east coast of the Falkland Islands, at a depth of 5 to 10 fathoms. The colony from which the dimensions given above are taken is a pyriform mass with a short and narrow stalk (Pl. XLIV. fig. 1). The stalk has been cut, but it was probably not more than 1 or 2 cm. in length.

The second specimen is very different in external appearance. It consists of a small rounded head attached to an enormously large peduncle. The head has evidently been injured, it looks as if the greater part of one side had been torn off, and what is left of that side is decayed and irregular: it measures 2·3 cm. in length, 2·1 cm. in breadth, and 1·5 cm. in greatest thickness. The peduncle is uneven, corrugated, and rough on the surface, is partially incrusted with colonies of Polyzoa, and has a few small black sand grains imbedded in its lower part. It measures 7·5 cm. in length, and is about 2 cm. in thickness. Throughout this great length of peduncle there are no Ascidiozooids, and although the head is incomplete, still there is no reason to suppose that it was any larger, if as large, as that of the other colony.

In both specimens the heads contain a large number of Ascidiozooids. In the pyriform specimen the branchial and atrial apertures of the Ascidiozooids are prominent and very conspicuous, even more so than is shown in the figure (Pl. XLIV. fig. 1). With a Coddington lens, or under a low power of the microscope, the apertures are seen to be distinctly four-lobed.

The region immediately around the branchial and atrial apertures is of a dark grey colour, with a slight bluish tinge, and in some cases of a decided slate colour, while the rest of the surface is much lighter (Pl. XLIV. fig. 1), being of a slightly hyaline whitish-grey. In the other specimen the head is of much the same colour as that just described, while the peduncle is of a dull grey colour throughout its length.

In sections the test is much lighter. In some places it is almost white, and has a distinct hyaline tint. It is very tough and cartilaginous, and contains vessels which branch and terminate in dilatations usually filled with blood-corpuscles. In sections through the test of the lower part of the colony imbedded sand grains are also found. In the injured specimen the apertures are scarcely so prominent as in the other, and are both irregularly four-lobed.

The test cells are in most places numerous, but in some regions they are very abundant, especially around the bodies of the Ascidiozooids. There they are always of a fusiform shape, and are placed with their long axes parallel to the surface of the Ascidiozooid. The opacity of the test is doubtless due to the presence of the slightly pigmented test

cells, as the matrix is clear and structureless, and the vessels are not sufficiently abundant to make any difference.

The muscle bands in the mantle are chiefly longitudinal, but transverse and oblique bands are also present in abundance. The sphincters are well developed, and large numbers of fine longitudinal muscle bands radiate from the bases of the two siphons.

The branchial sac differs from that of *Goodsiria placenta* in having no folds. It also has the stigmata on the whole rather larger and more regular (see Pl. XLIV. fig. 2, *sg.*). They are rounder than and not so long as those of *Goodsiria coccinea*, so that in the condition of the branchial sac the present species occupies a position between those of *Goodsiria placenta* and *Goodsiria coccinea*. The horizontal membranes on the transverse vessels are slight (Pl. XLIV. fig. 2, *tr.*).

The tentacles are rather short and stout, and, unlike those of *Goodsiria placenta*, they are all of the same size.

The œsophagus is long and narrow. It runs posteriorly and ventrally. The globular stomach has well-marked longitudinal folds. A transverse section shows (Pl. XLIV. fig. 3) that there is one very thick fold (*ty.*) and twelve slighter ones (*fd.*). They all project in for a considerable distance so as to greatly reduce the lumen. They are covered with ciliated columnar epithelium (*ep.*) The outer part of the stomach wall at the bases of the folds contains a large number of blood-vessels (Pl. XLIV. fig. 3, *b.v.*). The intestine runs anteriorly from the stomach, and then turns dorsally in a wide loop, and then anteriorly again to form the short rectum. The whole of the intestinal tract is very narrow.

The reproductive organs are in the form of polycarps imbedded in the mantle and projecting into the peribranchial cavity. These are unisexual, as in the case of *Synstyela incrustans*, and only female ones were found. Endocarps are also present attached to the mantle.

Goodsiria coccinea, Cunningham (Pl. XLV. figs. 1–19).

Goodsiria coccinea, Cunningham, Trans. Linn. Soc. Lond., vol. xxvii. p. 489.

The Colony is massive, and may be of rounded form, or elongated. It is attached by the lower end, is not pedunculated, and has the upper end wide and rounded. The surface is generally rather uneven, but smooth. The colour (after preservation in alcohol) is a pale bluish-grey.[1]

The length is 5 cm., the breadth is 2 cm., the thickness is 1 cm.

The Ascidiozooids are fairly large and numerous. They are distributed evenly over the surface of the colony, and are distinctly visible externally. The anterior end forms an elliptical area, generally 2 or 3 mm. in length, and bearing the conspicuous

[1] When living, according to Prof. R. O. Cunningham, it is scarlet.

branchial and atrial apertures, which are irregularly four-lobed. The bodies of the Ascidiozooids are slightly elongated antero-posteriorly, are of ellipsoidal form, and are not divided into regions. A large vascular appendage is given off from the posterior end of each.

The Test is firm and cartilaginous. In sections it is of a clear hyaline grey, and is semi-transparent. The matrix is crowded with minute test cells, and is delicately fibrillated. There are no bladder cells. Vessels are abundant, and branch freely; they terminate in ovate swollen bulbs.

The Mantle is strong, and has a well-developed musculature. The muscle bands run in all directions. The branchial and atrial sphincters are strong.

The Branchial Sac is large and well developed. It is not folded, but the internal longitudinal bars are well developed; they have no papillæ. The transverse vessels are moderately wide, and are all of about the same size. In addition there are intermediate much smaller transverse vessels which cross the meshes but do not interrupt the stigmata. Delicate horizontal membranes are present on the transverse vessels. The stigmata are long and narrow, and are arranged with regularity. The meshes are slightly elongated transversely, and contain each about eight stigmata.

The Alimentary Canal is not large. It lies alongside the branchial sac. The stomach is small and globular. It is folded longitudinally.

The Reproductive Organs are in the form of polycarps, which are imbedded in the mantle.

Localities.—(*a*) Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8 F. (nearly twenty specimens). (*b*) Station 314, January 21, 1876; lat. 51° 35′ S., long. 65° 39′ W.; depth, 70 fathoms; bottom, sand; bottom-temperature, 46° F. (four specimens). (*c*) Station 315, January 26, 1876; lat. 51° 40′ S., long. 57° 50′ W.; depth, 12 fathoms; bottom, sand and gravel (one specimen).

Various specimens collected during the Challenger Expedition, in the neighbourhood of the Strait of Magellan and the Falkland Islands, seem to belong to the species found by Dr. Cunningham in the same localities during the cruise of the "Nassau" in 1866 to 1869, and briefly described in 1871.[1] Cunningham also refers to the species in his work on the Strait of Magellan, and he gives figures showing a colony in surface view and in section, and some of the Ascidiozooids slightly magnified.

I have examined the specimens collected by Cunningham, and now in the British Museum, and have no doubt that the Challenger specimens belong to the same species. As, however, Cunningham's brief description and figures do not give the essential generic and specific characters, beyond the external appearance of the colony, and therefore only

[1] Notes on Reptiles, &c., obtained during the voyage of H.M.S. "Nassau," *Trans. Linn. Soc. Lond.*, vol. xxvii. p. 489.

serve to indicate the family to which the specimens belong, I have thought it necessary to give the above detailed description.

This species is a notable example of the little value that can be attached to the colour of specimens preserved in alcohol. All of the Challenger specimens are shades of a light slate blue, and those in the British Museum are of very much the same colour, but Cunningham states that the specimens when living were of a vivid scarlet hue, and I find in my notes that the late Sir Wyville Thomson had told me that the Challenger specimens were of the same colour.

The colonies may attain a large size. The dimensions given above are taken from a small specimen, and are only of value as an indication of the proportions of the colony. The smallest Challenger specimens (see Pl. XLV. fig. 2) measure only a few millimetres in length and breadth, while the largest colony is about 46 cm. in length, 3·5 cm. in breadth, and 1·5 cm. in thickness. Cunningham states that his specimens were more than 2 feet in length. Figure 1 on Plate XLV. represents the upper end of a large colony.

The form varies considerably. In the small specimens it is more or less rounded (Pl. XLV. fig. 2). In the larger ones it becomes elongated. The Ascidiozooids are fairly conspicuous on the surface. In some places only the apertures are visible (Pl. XLV. fig. 1). Sometimes these are prominent, at other times depressed. They are irregularly four-lobed when partially open, and cross-slit when closed (Pl. XLV. fig. 3).

A section through the colony shows that the Ascidiozooids occupy only the superficial layer (Pl. XLV. fig. 1); they vary in size from 1 mm. to 5 mm. Cunningham speaks of them as being very small, and 1 line long, but in his figures he represents them as being of different sizes, as they are in the Challenger specimens (Pl. XLV. fig. 1). The shape of the body of the Ascidiozooid is irregularly ovoid, with both apertures at the anterior end.

The test is massive, and is usually firm. In the specimens from Station 313 the test seems to be rather softer and more gelatinous than in those from Station 314 and Station 315; it is also more flexible and elastic; in other respects the specimens are the same.

The delicate fibres in the matrix run in all directions. The test cells are small, and are mostly of rounded form (Pl. XLV. fig. 4). The vessels are conspicuous; most of the larger ones are divided by a median septum which is double, so that three cavities are thus formed (see Pl. XLV. fig. 4). Besides the terminal bulbs, occasional ovate swellings occur upon the course of the vessels. A vessel covered by a layer of mantle leaves the posterior end of each Ascidiozooid close to the intestine (Pl. XLV. figs. 9, 12).

In the mantle the chief muscle bands run transversely and longitudinally, and form a rudely square-meshed network. Oblique bands are also present. There are a large number of blood sinuses in the mantle, which makes it rather opaque. The branchial and atrial sphincters are equally strong (Pl. XLV. fig. 3, *br.* and *at.*).

The internal longitudinal bars in the branchial sac are wide (Pl. XLV. figs. 7, 8, *i.l.*). The larger transverse vessels, which bound the rows of stigmata, are provided with delicate horizontal membranes, which are exactly like the alternate smaller transverse vessels which cross the meshes (Pl. XLV. fig. 7, *tr.* and *tr'.*).

The stigmata in the fully developed sac are long and narrow (Pl. XLV. fig. 7), and much larger than in the other species of the genus; but in the young sac they are shorter and more rounded, and closely resemble those of *Goodsiria placenta* and *Goodsiria pedunculata*. Figures 5 and 6 show the condition of the stigmata in the younger sacs, and figure 6 also shows, in the very young Ascidiozooid, an arrangement of the internal longitudinal bars which suggests the presence of three rudimentary folds. This interesting indication of a relationship to the branchial sac of *Goodsiria placenta* is totally lost as the Ascidiozooid grows older. The stigmata are very regular in the adult sac, and the ciliated cells are well marked (Pl. XLV. fig. 8).

The endostyle is well developed. Its course is straight. In a transverse section of the ventral part of the body (Pl. XLV. fig. 16) the structure and relations of the endostyle are well seen. Its ventral-most part is continuous with the mantle (*m.*), and so separates the right and left halves of the peribranchial cavity (Pl. XLV. fig. 16, *p.br.c.*). The cells on the floor of the endostyle bear very long cilia, which in a transverse section project as a large tuft (Pl. XLV. fig. 16, *en.*), while the sides bear shorter and less conspicuous cilia.

The œsophagus is short (Pl. XLV. fig. 17, *œ.*). It runs backwards and ventrally to open into the small globular stomach (*st.*). There are usually about six well-marked folds upon the right side of the stomach. A transverse section (Pl. XLV. fig. 18) shows in addition a single large fold, which projects far into the interior, nearly dividing it into two cavities. The intestine is wider than the œsophagus (Pl. XLV. fig. 17, *i.*). It runs ventrally for a short distance from the stomach, and then turns anteriorly and then dorsally in a wide loop, running parallel to the stomach and œsophagus till it reaches the dorsal edge of the body, where it again turns anteriorly to become the short rectum (Pl. XLV. fig. 17, *r.*). The anus (*a.*) has a reflected margin. The stomach is provided with a short cæcum projecting from its left hand side, and not visible in figure 17. It curves towards the intestine in a semicircle (Pl. XLV. fig. 19).

The polycarps are not very conspicuous, as they are deeply buried in the mantle (Pl. XLV. fig. 13). When dissected out they are seen to be ovoid or flask-shaped bodies (Pl. XLV. fig. 14), with short projecting ducts. They are hermaphrodite, the same polycarp containing both ova and spermatic vesicles (Pl. XLV. fig. 13, *o.* and *t.v.*). The oviduct and vas deferens are occasionally seen cut in sections in the form of small tubes, the former slit-like and the latter circular in section (Pl. XLV. fig. 13, *o.d.* and *v.d.*). A few endocarps are also present projecting from the mantle into the peribranchial cavity. They are of the usual irregular shapes, with corrugated outlines (Pl. XLV. fig. 15).

Although I have not found any buds in the colonies examined, I am inclined to think

that gemmation takes place in connection with the vascular prolongations from the bodies of the Ascidiozooids into the test. A well-marked vessel, enclosed in a prolongation of the mantle, leaves the posterior end of each Ascidiozooid (Pl. XLV. figs. 9, 12) and runs for a longer or shorter distance through the test before ending in a dilated bulb (Pl. XLV. fig. 9, *t.k.*). Usually the vessels branch considerably (Pl. XLV. fig. 4, *v.*). Figure 9 shows an unusually simple condition.

Figure 10 on Plate XLV. represents a transverse section through the terminal bulb of a vessel with its covering of mantle, and figure 11 shows a part of a similar section more highly magnified, exhibiting spaces in the connective tissue of the mantle under the columnar layer of ectoderm cells. The three layers seen in this section (Pl. XLV. fig. 11, *ec.*, *mes.*, and *end.*) are probably continuous with the ectoderm, the mesoderm, and the endoderm respectively of the body of the parent Ascidiozooid.

Bearing in mind the part which similar vascular appendages play in the process of gemmation in other Compound Ascidians, the probability is that here also the young Ascidiozooids are developed in connection with these enlarged terminal bulbs on the vessels. Cunningham speaks of *Goodsiria* as a "Social Ascidian," thereby expressing, I suppose, his belief that gemmation takes place by means of vascular stolons as in the case of the Clavelinidæ.

Synstyela, Giard.

Synstyela, Giard, Assoc. franç. pour l'avancem. d. Sci., t. iii. Lille, 1874.

Colony thin and incrusting.

Ascidiozooids large and closely placed, completely imbedded in the common test. Body not divided into thorax and abdomen.

Test relatively small in amount. Matrix sometimes fibrillated; test cells small; bladder-cells absent; vessels present.

Branchial Sac well developed. Rudimentary folds present. Internal longitudinal bars well marked.

Dorsal Lamina in the form of a plain membrane.

Tentacles well developed.

Alimentary Canal not prolonged behind the branchial sac. Stomach folded longitudinally.

Reproductive Organs in the form of polycarps attached to the mantle.

This genus is one of the two forms very briefly described by Giard in 1874,[1] the other one being *Polystyela*. It differs from *Polystyela* and *Thylacium* in having the Ascidiozooids depressed and not projecting above the general surface of the colony. From *Goodsiria* and *Oculinaria* it differs in forming thin incrusting colonies, while the

[1] *Assoc. franç.*, Lille, t. iii.

continuity of the layer distinguishes it from *Chorizocormus*. Alder's *Thylacium variegatum*, on account of its depressed Ascidiozooids, probably belongs to this genus. It is doubtful whether that species is distinct from Giard's species of *Synstyela*. The new Challenger species described below seems to agree well with what is known of this genus, but, as Giard does not give a detailed description, it is possible that his species may be generically distinct, and in that case *Synstyela incrustans* must become the type of a new genus.

As Giard has given neither a formal diagnosis of *Synstyela* nor the materials for forming one, I have drawn up the above generic description from the new species collected during the Challenger Expedition. Alder's description of his *Thylacium variegatum* agrees with the characters I have given, and there is nothing in Giard's few remarks contrary to them, consequently I believe they will prove satisfactory.

The new species *Synstyela incrustans* is almost certainly distinct from those previously described, but, from our imperfect knowledge of Giard's species, it is impossible to give here a tabular representation of the genus. *Synstyela* has a very wide distribution in space. It has been found on the coast of France, in the British Seas, in the Strait of Magellan, and off the Philippine Islands.

Synstyela incrustans, n. sp. (Pl. XLVI. figs. 9–14).

The Colony forms a flat expansion of irregular form, attached by more or less of the lower surface. It is frequently lobed. The upper surface is uneven but smooth. The colour is light grey, with a bluish or pink tint in some places.

The length is 4 cm., the breadth is 2·5 cm., and the thickness is 7 mm.

The Ascidiozooids are large and numerous. They are closely placed, and form slight rounded projections on the surface of the colony. The usual size of the anterior end is 4 mm. or 5 mm. The bodies are not elongated antero-posteriorly, and are not divided into regions. The branchial and atrial apertures are conspicuous, but they are not distinctly lobed.

The Test is firm and tough, but is not massive. The upper surface is stronger and more opaque than the internal part, which is hyaline and semi-transparent in most places. The matrix is delicately fibrillated in some regions. It contains small rounded test cells, but they are not numerous. There are no bladder cells. Vessels are present in the test, but they are not conspicuous. They are very abundant on the spreading edges of the colony, where they terminate in elongated swollen bulbs.

The Mantle is thin and delicate. Its musculature is feebly developed.

The Branchial Sac is large and well developed. It has rudimentary folds. The internal longitudinal bars are numerous and strong. The ordinary transverse vessels are usually wide and all of the same size, but there are also two or three intermediate much

smaller transverse vessels crossing each mesh but not interrupting the stigmata. The meshes are square, and contain each about six long narrow stigmata.

The Dorsal Lamina is a plain narrow membrane.

The Tentacles are of two sizes, placed alternately; they are numerous, and the larger ones are of considerable size.

The Dorsal Tubercle is small, and has an inconspicuous rounded aperture placed close to the anterior end of the dorsal lamina.

The Alimentary Canal is moderately large. It forms a narrow loop. The stomach is large and has well-marked longitudinal folds.

The Reproductive Organs are in the form of polycarps, which project from the inner surface of the mantle. They are unisexual, and the male and female polycarps differ in form. Endocarps are also present.

Localities.—(*a*) Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8 F. (*b*) Samboangan, in the Philippine Islands; depth, 10 fathoms.

A considerable number of specimens of this species were obtained off Cape Virgins, at the extremity of the Strait of Magellan, from a depth of 55 fathoms, and one small colony, which seems not to be distinguishable specifically from the others, was obtained off Samboangan, in the Philippine Islands, at a depth of 10 fathoms.

Most of the specimens from the Strait of Magellan are attached to large individuals of *Molgula gigantea*, and form incrusting layers over the upper part of the test. The edges of the colony are in some places very thin spreading membranes composed of test only, while in other places they form free projecting lobes and contain Ascidiozooids. A few of the colonies are not incrusting, but project upwards from a small area of attachment in the form of more or less lobed flattened expansions (Pl. XLVI. fig. 9).

The dimensions given above are those of a small colony. Some of the incrusting specimens attain a much larger size (upwards of 20 cm. in length). The thickness varies somewhat. The colour is always greyish, but in some cases it is a slaty blue-grey, while in others it has a distinctly pink tint. The anterior ends of the Ascidiozooids are very conspicuous on the surface. In some colonies they occupy the entire surface of the colony, being merely separated by lines (Pl. XLVI. fig. 9), but in others a small amount of investing mass of a distinctly lighter colour may be seen between the Ascidiozooids. The branchial and atrial apertures are obscurely four-lobed. They generally appear circular until carefully examined.

The Ascidiozooids are flattened antero-posteriorly, a very rare condition amongst Compound Ascidians. They vary in size from 1 mm. to 8 mm. in greatest diameter. The smaller ones are mostly placed in the thin spreading margins of the colony, but they occasionally occur between larger Ascidiozooids in the centre of the mass.

The test is small in amount in this species, being reduced to thin membranes and narrow bars separating and surrounding the bodies of the Ascidiozooids. The upper layer forms a membrane, which is distinctly tougher than the part below. The test cells are few in number and of small size, and throughout the greater part of the test the vessels are few and inconspicuous. On the thin expanded margins, however, they become more numerous, and are usually found filled with blood-corpuscles. The long ovate bulbs on the terminal twigs are well marked. They resemble those found in a similar position in some species of *Botryllus*.

The muscle bands in the mantle run transversely and longitudinally (Pl. XLVI. fig. 12), but they are delicate.

The branchial sac is very like that of some Styelinæ amongst Simple Ascidians. The narrow transverse vessels crossing the meshes are well marked and are normally three in number (Pl. XLVI. fig. 10, *tr'*.), but in many of the meshes one and sometimes two of them are absent. The meshes are usually square and of large size, but along certain tracts, especially on each side of the dorsal lamina, three or four of the internal longitudinal bars become more closely placed (see Pl. XLVI. fig. 10) so as to form rudimentary folds, such as are seen in the branchial sac of *Styela grossularia* and some allied forms. The larger transverse vessels are variable in calibre (Pl. XLVI. fig. 10, *tr.*). In some sacs they are much narrower than is shown in the figure. The internal longitudinal bars of the branchial sac are rather wide (Pl. XLVI. fig. 10, *i.l.*). A single row of very large meshes, containing each about twelve stigmata, lies between the dorsal lamina and the rudimentary fold. Both the endostyle and the dorsal lamina are narrow.

The stomach is pyriform and of considerable size. About eight longitudinal folds are visible upon its side. It tapers gradually into the intestine, which turns anteriorly and then dorsally and runs alongside the anterior edge of the stomach so as to form a very narrow intestinal loop. The shape and course of the alimentary canal resemble somewhat those of *Botrylloides tyreum*[1] (see Pl. II. fig. 7). The system of glandular tubules with dilated ends is well developed, and covers the greater part of the intestinal wall.

The polycarps are fairly numerous (Pl. XLVI. fig. 12); they are not imbedded in the mantle, but project freely into the peribranchial cavity in the form of ovate or pyriform bodies, with narrow bases or short stalks by which they are attached to the mantle, and long tubular projections upon which their ducts open (see Pl. XLVI. fig. 12). The male polycarps are usually smaller, and are more of an irregularly rounded form, with no visible projections, or only very short ones (Pl. XLVI. fig. 13). In the female polycarps the more mature ova occupy the upper part of the structure, while very young ova are found at the lower end, next to the stalk (Pl. XLVI. fig. 12). Female polycarps in various stages of development were noticed. They commence as one (Pl. XLVI. fig. 12, upper end) and then two or three young ova which are imbedded in the mantle,

[1] Named *Botrylloides purpureum* on plate.

and form a slight projection towards the peribranchial cavity (Pl. XLVI. fig. 12). As the number of ova and their size increases the projection becomes larger and the ova pass completely into it, thus forming a young polycarp, attached to the mantle by its base. Endocarps are also present on the inner surface of the mantle. They have the usual irregular form and soft grey appearance (Pl. XLVI. fig. 14, *en.c.*).

Tailed larvæ of large size are present in abundance in the peribranchial cavities of some of the Ascidiozooids. They have short ovate bodies and very large tails (Pl. XLVI. fig. 11). Adhering papillæ are present at the anterior end of the body, and the single pigmented sense-organ is situated nearer to the anterior than to the posterior end. The tail is provided with a wide membranous margin (Pl. XLVI. fig. 11), which is supported by transversely running rays or fibres exactly like those described by Giard [1] as being present in the larva of his *Polystyela lemirri*.

In external appearance this species shows a certain resemblance to aggregations of *Styela grossularia* and some other allied Simple Ascidians such as are formed where individuals are closely crowded together and become attached to their neighbours' tests. The presence, however, of the thin spreading test margin at the edges of the colony, and of the numerous vessels with their dilated bulbs, shows that this is a colony and not merely an aggregation of individuals. The manner in which the young Ascidiozooids are imbedded in the test is also very different from the condition found in *Styela grossularia*, where, when aggregations take place, the young Ascidiozooids are merely slightly attached to the surface of the test of the older individuals, and only become firmly and closely united with them as they grow older and the test increases in amount.

The specimen from Samboangan may possibly prove, when more specimens are examined, to be a distinct variety. It is a small colony incrusting a fragment of an Alga, and is rather darker in colour than the specimens from the Strait of Magellan, and the Ascidiozooids seem to be of smaller size. The only difference I have detected in the internal structure is in the branchial sac, where, in the Samboangan specimen, there are no delicate transverse vessels crossing the meshes.

Chorizocormus,[2] n. gen.

Colony consisting of a number of distinct masses of small size united by irregular branched stolons.

Ascidiozooids placed either singly or in small groups in the test. When more than one is present they do not project above the general level. The body is not divided into thorax and abdomen.

Test relatively small in amount, slightly incrusted with sand. Test cells few, and bladder cells absent. Vessels present in the test and stolons.

[1] *Assoc. franç.*, t. iii., 1874.

[2] χωρίζω and κορμός.

Branchial Sac well developed. Rudimentary folds present. Internal longitudinal bars strong.
Dorsal Lamina in the form of a plain narrow membrane.
Tentacles well developed.
Alimentary Canal not prolonged behind the branchial sac.
Reproductive Organs in the form of polycarps.

This genus is founded for a remarkable species, several colonies of which were found at Kerguelen Island. It differs from all the other Polystyelidæ in producing colonies which are not continuous masses or layers of test in which the Ascidiozooids are imbedded, but consist of small rounded masses joined irregularly by creeping and sometimes branched stolons. This condition suggests at first a similarity to the Clavelinidæ amongst Ascidiæ Simplices, but the structure of the Ascidiozooids shows that if the genus is allied to Simple Ascidians it is not through the Clavelinidæ but rather through *Polycarpa* in the Cynthiidæ. The stolons, like those of the Clavelinidæ, consist of test penetrated by vascular prolongations from the Ascidiozooids, but that similarity does not, I believe, indicate any close or direct relationship.

In the table given on p. 326 I have placed the present genus in the section of the family where the Ascidiozooids are completely imbedded in the common test, but occasionally single Ascidiozooids are found isolated, being only connected with the rest of the colony by narrow stolons, and in such cases they project considerably above the surface. But wherever several Ascidiozooids are placed together in a mass they are completely imbedded and do not project. If *Chorizocormus* had been placed in the first section in the table, then it would have been readily separated from *Thylacium* by its Ascidiozooids having no abdomen, and from *Polystyela* by the remarkable shape of the colony. The characters will be discussed further under the description of the single known species of the genus.

This form is a valuable link between the other Polystyelidæ on the one hand and the Cynthiidæ amongst Simple Ascidians on the other (see Summary and General Remarks at the end of this Report).

Chorizocormus reticulatus, n. sp. (Pl. XLVI. figs. 1–8).

The Colony has the form of a number of more or less rounded masses of small size united by irregular creeping stolons, which may branch to form a rude network. The surface is moderately smooth, but is slightly incrusted with sand. The colour is light grey.

The size of the species varies greatly. The largest colony is about 15 cm. in length, and the smallest is less than 1 cm.

The Ascidiozooids are not large, and they are not very numerous. As a rule there is one Ascidiozooid in each of the rounded masses of the colony, but in some cases several Ascidiozooids are placed together in one mass; the apertures are in most cases placed upon slight papillæ projecting from one end of the Ascidiozooid; they are both four-lobed. The body of the Ascidiozooid is not elongated, and is not divided into regions.

The Test is thin, and tough and leathery, but not stiff. It is quite opaque. The matrix is minutely fibrillated in places. There are a few small rounded test cells, but no bladder cells are present. Vessels are found ramifying through the test. They are rather narrow, and do not branch much; the terminal twigs end in small rounded knobs. The stolons are penetrated by vessels.

The Mantle is strong, and has a well-developed musculature. The branchial and atrial sphincters are powerful.

The Branchial Sac is large and well-developed. Rudimentary folds are present, and the internal longitudinal bars are strong and conspicuous. The transverse vessels are moderately wide, and have slight horizontal membranes. The meshes are slightly elongated transversely, and contain each six or seven stigmata. They are divided by delicate transverse vessels which do not interrupt the long narrow stigmata.

The Dorsal Lamina is a plain narrow membrane with no ribs and no marginal teeth.

The Tentacles are rather short and stout. There are about twenty-four of them, and they are of two sizes placed alternately.

The Dorsal Tubercle is very large. It is elongated antero-posteriorly, and extends from the base of the tentacles to the dorsal lamina. The aperture is a long narrow slit.

The Alimentary Canal lies alongside the posterior part of the branchial sac. It is not large. The stomach has no well-marked folds.

The Reproductive Organs are in the form of polycarps, which are attached to the mantle. They are of small size, and are unisexual.

Locality.—Station 149D, January 20, 1874; Royal Sound, Kerguelen Island; lat. 49° 28′ S., long. 70° 13′ E.; depth, 28 fathoms; bottom, volcanic mud.

Station 149E, January 21, 1874; Greenland Harbour, Kerguelen; lat. 49° 37′ S., long. 70° 16′ E.; depth, 30 fathoms; bottom, volcanic mud.

Two large and several small colonies of this interesting species were obtained with the dredge from a depth of 30 fathoms in Royal Sound, Kerguelen Island.

Many of the Ascidiozooids are almost completely independent of one another (Pl. XLVI. fig. 2), being merely united by basal creeping stolons as in the case of the Clavelinidæ, but in other parts of the colony two or more Ascidiozooids may be found imbedded in the same mass of test (Pl. XLVI. fig. 3) as in the case of other Compound Ascidians. This species is therefore on the border line between the two groups, and

if it was an isolated form it would be extremely difficult if not impossible to determine whether it should be regarded as a Simple or a Compound Ascidian. It is, however, so closely allied to *Synstyela incrustans* and other members of the family Polystyelidæ, that it becomes an easier matter to trace its connection with true Compound Ascidians than with true Simple Ascidians, and therefore I have placed it in its present position amongst the Polystyelidæ. Its affinities will be further discussed in the General Summary at the end of the Report.

The masses of test containing several Ascidiozooids are each of various forms (see Pl. XLVI. figs. 1–4), and are connected with one another by narrow bands of test. The larger colonies (Pl. XLVI. fig. 1) consist of a very large number of these masses united by their stolons to form a very irregular mass clinging closely to some foreign body. The smaller colonies consist of several of the little masses, or of a few independent Ascidiozooids joined by the usual stolons (Pl. XLVI. figs. 2, 3, 4). As may be seen from figures 2 and 3, the masses differ considerably in their size. The average size is 2 or 3 mm. in diameter. The side branches given off from the stolons are frequently thickened at their ends so as to form small knobs (Pl. XLVI. figs. 1–4). The whole of the outer surface of the colony is slightly incrusted with fine black sand grains, otherwise it is of a dull but light grey, and fairly smooth.

The Ascidiozooids vary in size from about 1 mm. up to 8 mm. antero-posteriorly. The larger ones are generally independent of their neighbours, and have a striking resemblance to individuals of some of the smaller species of *Styela* and *Polycarpa*. The apertures in these large Ascidiozooids are placed on long tapering siphons. They are square when open and cross-slit when closed.

The test is relatively small in amount in this species. Where it covers the body of an Ascidiozooid it is a thin tough layer, slightly sandy on its outer surface, and perfectly smooth and glistening internally. The Ascidiozooid can readily be shelled out from its coating of test, as the mantle does not adhere to it very closely. The stolons are entirely formed by test. The vessels are not numerous, but they are present in all parts of the colony. One or more may always be found in the stolon running longitudinally, and occasionally giving off lateral branches which may be long or short (Pl. XLVI. fig. 5, *t. k.*). The terminal knobs are short and globular. The ectoderm cells on the surface of the vessels are very distinct (Pl. XLVI. fig. 5, *v.*).

The branchial and atrial sphincters are wide. They extend over nearly the whole of the elongated siphons. Both longitudinal and transverse muscle bands are found over the mantle generally; they form a close network (Pl. XLVI. fig. 8).

The branchial sac has a single rudimentary fold upon each side. It lies close to the dorsal lamina, and consists of four closely placed internal longitudinal bars. It is separated from the dorsal lamina by a single row of very wide meshes, each of which contains about a dozen stigmata. The transverse vessels and the internal longitudinal

bars are both well developed (Pl. XLVI. fig. 6, *tr.* and *i.l.*). The fine transverse vessels crossing the meshes (*tr'.*) are present with great regularity. The stigmata are long and narrow, like those of *Synstyela incrustans.*

The endostyle is conspicuous. Its course is straight. The tentacles are numerous, but none of them are very long. In the first specimen examined there were twelve long and about twelve smaller intermediate ones, while in the second specimen there were about sixteen larger and the same number of smaller tentacles. The smaller tentacles are frequently irregular in position and size (Pl. XLVI. fig. 7, *tn.*, *tn'.*); they are sometimes very minute.

The prebranchial zone lying between the tentacular circle and the peripharyngeal band is slightly papillated in places; it is rather narrow. The peripharyngeal band bends posteriorly at the dorsal edge to form a slight triangular peritubercular area (Pl. XLVI. fig. 7) which receives the posterior end of the large dorsal tubercle. In some cases this organ is not so exactly antero-posterior in direction as is shown in the figure (Pl. XLVI. fig. 7, *d.t.*), but is slightly inclined. The aperture is much elongated, and is not coiled at its ends. This dorsal tubercle is in a very different condition from that of *Synstyela incrustans;* it is frequently the case amongst Ascidians that closely allied species have very differently shaped dorsal tubercles.

The stomach is fairly large, but is thin-walled; the intestine is short. There are a large number of small polycarps projecting into the peribranchial cavity. They are of rounded or pyriform shapes (Pl. XLVI. fig. 8, *g.*), and are not deeply imbedded in the mantle; the ducts open upon small terminal papillæ. Most of those examined contained ova only (Pl. XLVI. fig. 8), but a few male ones were also found. No larvæ were discovered in the colony.

GEOGRAPHICAL DISTRIBUTION.

The introductory caution as to the insufficiency of our knowledge of the Geographical Distribution of Simple Ascidians which was given at the commencement of the corresponding section in the First Part of this Report applies with equal if not even greater force to the case of the Compound Ascidians. Still it may be of use to future investigators if the Challenger observations, so far as they have gone, are recorded and tabulated here; and the general arrangement and division into regions adopted in the First Part of the Report will be adhered to in order that a comparison of the results, in the case of the Simple and of the Compound Ascidians, may be readily made. In the map which will be found at the end of this Report the Geographical Distribution of the Simple as well as of the Compound Ascidians is indicated.

The track of the Challenger round the world has been divided into a series of comparatively short stages, so as to show roughly the localities between which the different observing Stations lie. These stages are arranged in the order in which they were traversed by the Expedition, and consequently the Stations are in chronological order, and the lists of species occur in the order in which they were collected. The chief objects of this arrangement are to show—(1) the approximate positions of the Stations at which Compound Ascidians were obtained, and (2) the list of species from each Station.[1]

The red circles on the map indicate the Stations at which Tunicata were obtained.

Between England and the Canary Islands no Compound Ascidians were obtained.

Between the Canary Islands and the West Indies no Compound Ascidians were obtained.

Between the West Indies and Halifax, Nova Scotia, the following Compound Ascidians were obtained:—

Off Bermuda; shallow water.

Botrylloides nigrum.
Symplegma viride.
Didemnum inerme.

[1] In the case of a few of the species the locality at which the specimens were obtained is not known. These species, of course, do not occur in the lists.

Station 48, May 8, 1873; lat. 43° 4′ N., long. 64° 5′ W.; depth, 51 fathoms; bottom, rock.

Aplidium despectum.

Between Halifax and Bermuda no Compound Ascidians were obtained.

Between Bermuda and the Canary Islands the following Compound Ascidian was obtained:—

Station 75, July 2, 1873; lat. 38° 38′ N., long. 28° 28′ 30″ W.; depth, 450 fathoms; bottom, volcanic mud.

——— (?) *clava.*

Between the Canary Islands and Bahia, Brazil, the following Compound Ascidians were obtained:—

Off San Iago, Cape Verde Islands; depth, 10 to 125 fathoms.

Leptoclinum albidum.

Off Barra Grande; depth, 400 fathoms.

Cystodytes draschii.

Between Bahia and the Cape of Good Hope the following Compound Ascidians were obtained:—

Off Bahia; shallow water.

Aplidium crassum.
Leptoclinum speciosum.
Leptoclinum speciosum, var. *asperum.*
Leptoclinum annectens.
Diplosoma macdonaldi.

Between the Cape of Good Hope and Kerguelen Island the following Compound Ascidians were obtained:—

Simon's Bay, Cape of Good Hope; depth, 10 to 20 fathoms.

Atopogaster elongata, var. *pallida.*
Leptoclinum albidum.
Goodsiria placenta.
Goodsiria placenta, var. *fusca.*

Station 141, December 17, 1873; lat. 34° 41′ S., long. 18° 36′ E.; depth, 98 fathoms; bottom, green sand; bottom temperature, 49°·5.

Psammaplidium exiguum.

Station 142, December 18, 1873; lat. 35° 4′ S., long. 18° 37′ E.; depth, 150 fathoms; bottom, green sand; bottom temperature, 47°.

Amaroucium colelloides.
Psammaplidium subviride.
Leptoclinum edwardsi.

Off Marion Island; depth, 50 to 75 fathoms

Sidnyum pallidum.

Station 147, December 30, 1873; lat. 46° 16′ S., long. 48° 27′ E.; depth, 1600 fathoms; bottom, Diatom ooze; bottom temperature, 34°·2.

Pharyngodictyon mirabile.

Between Kerguelen Island and Melbourne, Australia, the following Compound Ascidians were obtained:—

Station 149A, Betsy Cove, Kerguelen, January 14, 1874; lat. 49° 8′ S., long. 70° 9′ E.; depth, 40 fathoms; volcanic mud.

Colella quoyi.

Station 149C, Balfour Bay, Kerguelen Island, January 19, 1874; lat. 49° 32′ S., long. 70° 0′ E.; 20 to 60 fathoms; volcanic mud.

Colella pedunculata.
Morchellium giardi.
Polyclinum minutum.
Aplidium fuscum.
Amaroucium variabile.
Leptoclinum rubicundum.

Station 149D, Royal Sound, Kerguelen, January 20, 1874; lat. 49° 28′ S., long. 70° 13′ E.; 0 to 30 fathoms; volcanic mud.

————(?) *pyriformis.*
Aplidium fumigatum.
Amaroucium variabile.
,, ,, var. *tenerum.*
,, *nigrum.*
Leptoclinum subflavum.
Chorizocormus reticulatus.

Off Christmas Harbour, Kerguelen, January 29, 1874; depth, 50 to 120 fathoms.

Amaroucium complanatum.
Psammaplidium retiforme.

Kerguelen; 10 to 100 fathoms.

Colella pedunculata.
,, *concreta.*
Tylobranchion speciosum.
Morchellioides affinis.
Polyclinum pyriforme.
Aplidium leucophæum.
,, *fumigatum.*
Amaroucium variabile.
,, ,, var. *tenerum.*
,, *globosum.*

Station 151, February 7, 1874; lat. 52° 59′ 30″ S., long. 73° 33′ 30″ E.; depth, 75 fathoms; volcanic mud.

Colella pedunculata.

Between Melbourne, Australia, and New Zealand the following Compound Ascidians were obtained:—

Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; depth, 38 to 40 fathoms; bottom, sand and shells.

Colella murrayi, var. *rubida.*
Atopogaster aurantiaca.[1]
Amaroucium albidum.[1]
Didemnum aurantiacum.

Station 163D, June 12, 1874; lat. 33° 57′ 30″ S., long. 151° 39′ 15″ E.; depth, 120 fathoms; green sand.

Colella murrayi.

Port Jackson, Sydney, Australia; depth, 7 to 30 fathoms.

Colella elongata.
Polyclinum fungosum.
Psammaplidium spongiforme.
Leptoclinum (?) jacksoni.

Between New Zealand and the Fiji Islands the following Compound Ascidian was obtained:—

Off Tongatabu, Friendly Islands.

Leptoclinum tonga.

[1] The label in the bottle gives 85 fathoms as the depth from which these species were obtained.

Between the Fiji Islands and Hong Kong, China, the following Compound Ascidians were obtained :—

Station 186, September 8, 1874 ; lat. 10° 30′ S., long. 142° 18′ E. ; depth, 8 fathoms ; bottom, coral mud.

Psammaplidium pyriforme.

Station 187, September 9, 1874 ; lat. 10° 36′ S., long. 141° 55′ E. ; depth, 6 fathoms ; coral mud.

Colella pulchra.

Torres Strait ; depth, 3 to 11 fathoms.

Polyclinum depressum.
Psammaplidium ovatum.

Off the Arrou Islands.

Diplosomoides molle.

Between Hong Kong and New Guinea the following Compound Ascidians were obtained :—

Station 208, January 17, 1875 ; lat. 11° 37′ N., long. 123° 31′ E.; depth, 18 fathoms ; bottom, blue mud.

Botrylloides tyreum.

Off Zebu, Philippine Islands ; shallow water.

Aplidium fumigatum.

Station 209, January 22, 1875 ; lat. 10° 14′ N., long. 123° 54′ E.; depth, 95 fathoms ; bottom, blue mud ; bottom temperature, 71°.

Leptoclinum albidum, var. *grande.*

Samboangan, Philippine Islands ; depth, 10 fathoms.

Cystodytes philippinensis.
Leptoclinum moseleyi.
Synstyela incrustans.

Station 212, January 30, 1875 ; lat. 6° 54′ N., long. 122° 18′ E.; depth, 10 fathoms ; bottom, sand.

Botrylloides perspicuum.
,, ,, var. *rubicundum.*
Colella thomsoni.
Distaplia vallii.

Between New Guinea and Japan the following Compound Ascidians were obtained:—

Station 233A, May 19, 1875; lat. 34° 38′ N., 135° 1′ E.; depth, 50 fathoms; sand.

Leptoclinum japonicum.

Between Japan and the Sandwich Islands no Compound Ascidians were obtained.

Between the Sandwich Islands and Valparaiso no Compound Ascidians were obtained.

Between Valparaiso and the Falkland Islands the following Compound Ascidians were obtained:—

Station 308, January 5, 1876; lat. 50° 8′ 30″ S., long. 74° 41′ W.; depth, 175 fathoms; blue mud.

Leptoclinum tenue.

Station 311, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ W.; depth, 245 fathoms; bottom, blue mud; bottom temperature, 46°·0.

Colella ramulosa.
Amaroucium recumbens.
Leptoclinum tenue.
„ *propinquum.*

Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; bottom, sand; bottom temperature, 47°·8.

Colella pedunculata.
Atopogaster gigantea.
„ *elongata.*
Polyclinum incertum
Amaroucium irregulare.
„ „ var. *concinnum.*
„ *lævigatum.*
———— (?) *ignotus.*
Goodsiria coccinea.
Synstyela incrustans.

Station 314, January 21, 1876; lat. 51° 35′ S., long. 65° 39′ W.; depth, 70 fathoms; bottom, sand; bottom temperature, 46°.

Goodsiria coccinea.

Between the Falkland Islands and Buenos Ayres, South America, the following Compound Ascidians were obtained :—

Station 315, January 26 to 28, 1876; lat. 51° 40′ S., long. 57° 50′ W.; depth, 5 to 12 fathoms; bottom, sand and gravel.

Colella pedunculata.
„ *gaimardi.*
Amaroucium pallidulum.
Goodsiria pedunculata.
„ *coccinea.*

Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2.

Polyclinum molle.
Aplidium incrustans.
Psammaplidium effrenatum.
„ *flavum.*
Leptoclinum tenue.

Between Buenos Ayres and England no Compound Ascidians were obtained.

The above lists have given information in regard to the bathymetrical as well as the geographical distribution of the species, but a better general notion of the latter alone may be obtained by grouping the Stations at which Compound Ascidians were collected into the series of geographical regions given below.[1] The object in this arrangement is to show the Compound Ascidian fauna of each of these regions, so far as it has been made known by the Challenger investigations.

In the North Atlantic (East) the following Compound Ascidians were obtained :—

At Station 75.
——— (?) *clava.*

Off Cape Verde Islands.
Leptoclinum albidum.

In the North Atlantic (West) the following Compound Ascidians were obtained :—

Off Bermuda.
Botrylloides nigrum.
Symplegma viride.
Didemnum inerme.

[1] In this case all details as to the exact position, depth, temperature, &c., of the Stations have been omitted, as these have already been given in full in the first list.

At Station 48.

Aplidium despectum.

Off the east coast of South America the following Compound Ascidians were obtained :—

Off Barra Grande.

Cystodytes draschii.

Off Bahia.

Aplidium crassum.
Leptoclinum speciosum.
„ „ var. *asperum.*
„ *annectens.*
Diplosoma macdonaldi.

At the Cape of Good Hope and the neighbourhood the following Compound Ascidians were obtained :—

At Simon's Bay.

Atopogaster elongata, var. *pallida.*
Leptoclinum albidum.
Goodsiria placenta.
„ „ var. *fusca.*

At Station 141.

Psammaplidium exiguum.

At Station 142.

Amaroucium colelloides.
Psammaplidium subviride.
Leptoclinum edwardsi.

In the Southern Ocean the following Compound Ascidians were obtained :—

Off Marion Island.

Sidnyum pallidum.

At Station 147.

Pharyngodictyon mirabile.

At Kerguelen Island.

Colella pedunculata.
,, *quoyi.*
,, *concreta.*
——— (?) *pyriformis.*
Tylobranchion speciosum.
Morchellioides affinis.
Morchellium giardi.
Polyclinum minutum.
,, *pyriforme.*
Aplidium fuscum.
,, *leucophæum.*
,, *fumigatum.*
Amaroucium variabile.
,, ,, var. *tenerum.*
,, *globosum.*
,, *nigrum.*
,, *complanatum.*
Psammaplidium retiforme.
Leptoclinum rubicundum.
,, *subflavum.*
Chorizocormus reticulatus.

At Station 151.

Colella pedunculata.

On the south-east coast of Australia the following Compound Ascidians were obtained :—

At Station 162.

Colella murrayi, var. *rubida.*
Atopogaster aurantiaca.
Amaroucium albidum.
Didemnum aurantiacum.

At Station 163D.

Colella murrayi.

At Port Jackson.

Colella elongata.
Polyclinum fungosum.
Psammaplidium spongiforme.
Leptoclinum (?) *jacksoni.*

In the Southern Pacific Ocean the following Compound Ascidian was obtained :—

Off Tongatabu.

Leptoclinum tonga.

In the Seas of the Malay Archipelago the following Compound Ascidians were obtained :—

At Station 186.

Psammaplidium pyriforme.

At Station 187.

Colella pulchra.

In Torres Strait.

Polyclinum depressum.
Psammaplidium ovatum.

Off the Arrou Islands.

Diplosomoides molle.

At Station 208.

Botrylloides tyreum.

Off Zebu, Philippine Islands.

Aplidium fumigatum.

At Station 209.

Leptoclinum albidum, var. *grande.*

Off Samboangan, Philippine Islands.

Cystodytes philippinensis.
Leptoclinum moseleyi.
Synstyela incrustans.

At Station 212.

Botrylloides perspicuum.
" " var. *rubicundum.*
Colella thomsoni.
Distaplia vallii.

Off Japan the following Compound Ascidian was obtained :—

At Station 233A.

Leptoclinum japonicum.

Off the southern end of South America the following Compound Ascidians were obtained :—

At Station 308.

Leptoclinum tenue.

At Station 311.

Colella ramulosa.
Amaroucium recumbens.
Leptoclinum tenue.
,, *propinquum.*

At Station 313.

Colella pedunculata.
Atopogaster gigantea.
,, *elongata.*
Polyclinum incertum.
Amaroucium irregulare.
,, ,, var. *concinnum.*
,, *lævigatum.*
——————— (?) *ignotus.*
Goodsiria coccinea.
Synstyela incrustans.

At Station 314.

Goodsiria coccinea.

At Station 315.

Colella pedunculata.
,, *gaimardi.*
Amaroucium pallidulum.
Goodsiria pedunculata.
,, *coccinea.*

At Station 320.

Polyclinum molle.
Aplidium incrustans.
Psammaplidium effrenatum.
,, *flavum.*
Leptoclinum tenue.

These lists seem to indicate that Compound Ascidians are very much more abundant at some localities (*e.g.*, Simon's Bay, Kerguelen Island, Station 162, Station 313) than at others; but it must be noted that in the case of Kerguelen Island the length of the list is due, to a certain extent, to the very considerable time (several weeks) spent by the Expedition in investigating that region. Some areas in the above list, however, in which there were a large number of observing Stations, show singularly few Compound Ascidians. For example, no specimens were obtained in the South Atlantic between Bahia and Simon's Bay (see the Map, where the red circles indicate the Stations at which Simple or Compound Ascidians were found), only a single species was obtained in the South Pacific Ocean, and none in the North Pacific. On the other hand, some of the more limited areas have long lists of species; for example, twenty-one species were found in the immediate neighbourhood of Kerguelen Island, nine species on the south-eastern coast of Australia, and fourteen species in the Strait of Magellan.

In the table given below, the geographical regions already made use of have been grouped together to form seven great areas,[1] namely :—

(1) The North Atlantic,
(2) The South Atlantic,
(3) The Southern Ocean (the region lying to the south of the Indian Ocean, and including Kerguelen Island),
(4) The seas of the Malay Archipelago (the area lying between Australia and China),
(5) The North Pacific,
(6) The South Pacific, and
(7) The shores of the southern end of South America from Valparaiso on the west coast to Monte Video on the east.

This last named area has been separated from the South Atlantic and the South Pacific Oceans, to which its eastern and its western parts should respectively belong, because of the large number of Compound Ascidians which were found on the Patagonian coasts, and the difficulty of dividing them naturally into an east coast and a west coast series.

As the species are arranged in systematic order, this table shows at a glance the distribution of any particular species, genus, or family in the great ocean basins, according to the Challenger investigations.

[1] Indicated by the red numbers 1 to 7 in the map at the end of the Report.

TABLE SHOWING THE DISTRIBUTION OF THE FAMILIES, GENERA, AND SPECIES OF ASCIDIÆ COMPOSITÆ[1] THROUGHOUT THE GREAT OCEAN BASINS.

SPECIES.	1. North Atlantic.	2. South Atlantic.	3. Southern Ocean.	4. Seas of Malay Archip.	5. North Pacific.	6. South Pacific.	7. Seas of South America.
Family BOTRYLLIDÆ.							
Botrylloides tyreum				+			
perspicuum				+			
var. *rubicundum*				+			
nigrum	+						
fulgurale	+						
Sarcobotrylloides wyvillii	+						
Polycyclus lamarcki	+						
jeffreysi	+						
Family DISTOMIDÆ.							
Colella pedunculata			+				+
thomsoni				+			
gaimardi							+
pulchra				+			
elongata						+	
quoyi			+				
murrayi						+	
var. *rubida*						+	
ramulosa							+
concreta			+				
Distaplia vallii	+			+			
——— (?) *clava*	+						
——— (?) *pyriformis*			+				
Cystodytes draschii		+					
philippinensis				+			
Symplegma viride	+						
Family POLYCLINIDÆ.							
Pharyngodictyon mirabile			+				
Tylobranchion speciosum			+				
Atopogaster gigantea							+
aurantiaca						+	
informis							
elongata							+
var. *pallida*		+					
Morchellioides affinis			+				
Morchellium giardi			+				

[1] Those collected during the "Lightning," "Porcupine," and Challenger Expeditions.

Species.	1. North Atlantic.	2. South Atlantic.	3. Southern Ocean.	4. Seas of Malay Archip.	5. North Pacific.	6. South Pacific.	7. Seas of South America.
Sidnyum pallidum,			+				
Polyclinum pyriforme,			+				
fungosum,						+	
depressum,				+			
molle,		+					
incertum,							+
minutum,			+				
Aplidium incrustans,		+					
fuscum,			+				
leucophœum,			+				
crassum,		+					
fallax,	+						
despectum,	+						
fumigatum,			+	+			
Amaroucium variabile,			+				
var. *tenerum*,			+				
globosum,			+				
complanatum,			+				
irregulare,							+
var. *concinnum*,							+
pallidulum,							+
recumbens,							+
hepaticum,							
lævigatum,							+
colelloides,		+					
albidum,						+	
nigrum,							+
Psammaplidium spongiforme,						+	
effrenatum,							+
rude,							
subviride,		+					
exiguum,		+					
ovatum,				+			
retiforme,			+				
flavum,							+
pyriforme,				+			
——— (?) *ignotus*,							+
Family Didemnidæ.							
Didemnum savignii,			+				
aurantiacum,						+	
inerme,	+						
Leptoclinum tonga,						+	
moseleyi,				+			

Species.	1. North Atlantic.	2. South Atlantic.	3. Southern Ocean.	4. Seas of Malay Archip.	5. North Pacific.	6. South Pacific.	7. Seas of South America.
Leptoclinum speciosum,		+					
var. *asperum*,		+	+				
annectens,		+					
tenue,	+	+					+
var. *magnizooidium*,	+						
propinquum,							+
neglectum,							
albidum (?),	+	+					
var. *luteolum* (?),	+						
var. *grande*,				+			
subflavum,			+				
jeffreysi,	+						
carpenteri,	+						
thomsoni,	+						
edwardsi,		+					
japonicum,					+		
Leptoclinum (?) *jacksoni*,						+	
rubicundum,			+				
Family Diplosomidæ.							
Diplosomoides molle,				+			
Diplosoma macdonaldi,		+					
Family Cœlocormidæ.							
Cœlocormus huxleyi,							+
Family Polystyelidæ.							
Goodsiria placenta,		+					
var. *fusca*,		+					
pedunculata,							+
coccinea,							+
Synstyela incrustans,				+			+
Chorizocormus reticulatus,			+				
Total number of species or varieties which occurred in each of the seven areas	18	17	24	15	1	10	21

The preceding Table shows—first, that the Challenger Expedition obtained Compound Ascidians in all of the seven great areas into which the seas of the globe have been divided; and, secondly, that comparatively few species were found in the Pacific Oceans. This is somewhat surprising, since more species of Simple Ascidians were collected in the South Pacific area than in any of the other regions.[1]

The Botryllidæ appear to be almost entirely confined to the North Atlantic, the only exceptions—according to the Challenger investigations—being the two species and a variety of *Botrylloides* which were obtained at or near the Philippine Islands.

The Distomidæ are distributed throughout all the oceanic areas with the exception of the North Pacific, and the genus *Colella* is represented in at least four of them, the Southern Ocean, the seas of the Malay Archipelago, the South Pacific, and the seas of South America.

The great family Polyclinidæ is also found in all the regions except the North Pacific; more species are found in the Southern Ocean than elsewhere. Some of the larger genera, such as *Polyclinum*, *Aplidium*, *Amaroucium*, and *Psammaplidium*, have a very wide range.

The Didemnidæ occur in all the seven areas, the single Compound Ascidian (*Leptoclinum japonicum*) found in the North Pacific being a species of this family. The genus *Leptoclinum* (the largest genus in the Challenger Collection) is represented in all the regions, but is more abundant in the North and South Atlantic than elsewhere.

The Challenger Diplosomidæ occur in the South Atlantic and in the Malay region. The family was previously known from the North Atlantic area. The Cœlocormidæ are only known from the South American region.

The family Polystyelidæ has a wide range. It was previously known from the North Atlantic area, and the Challenger investigations have shown that it is also represented in the South Atlantic, the Southern Ocean, the Malay seas, and the South American region. No members of the family have yet been discovered in the Pacific Ocean.

Probably the most important conclusion to be drawn from the table is the wide distribution of most of the families and genera.

In the following table, the last illustrating the geographical distribution of the Ascidiæ Compositæ, the occurrence of the different genera and species according to the latitude is shown in both northern and southern hemispheres. A + means merely that the species opposite which it is placed was found by the Challenger Expedition somewhere between the limits of latitude which the column represents. Hence it may indicate more than one occurrence of the same species.

[1] See Part I. of this Report (vol. vi., 1882), p. 262.

North Latitude.					Species.	South Latitude.				
65°-40°[1]	40°–30°	30°–20°	20°–10°	10°–0°		0°–10°	10°–20°	20°–30°	30°–40°	40°–55°
			+		*Botrylloides tyreum,*					
				+	*perspicuum,*					
				+	v. *rubicundum,*					
	+				*nigrum,*					
+					*fulgurale,*					
+					*Sarcobotrylloides wyvillii,*					
+					*Polycyclus lamarcki,*					
	+				*jeffreysi,*					
					Colella pedunculata,					+
				+	*thomsoni,*					
					gaimardi,					+
					pulchra,		+			
					elongata,				+	
					quoyi,					+
					murrayi,				+	
					var. *rubida,*				+	
					ramulosa,					+
					concreta,					+
	+			+	*Distaplia vallii,*					
	+				—— (?) *clava,*					
					—— (?) *pyriformis,*					+
					Cystodytes draschii,	+				
				+	*philippinensis,*					
	+				*Symplegma viride,*					
					Pharyngodictyon mirabile,					+
					Tylobranchion speciosum,					+
					Atopogaster gigantea,					+
					aurantiaca,				+	
					informis,					
					elongata,					+
					var. *pallida,*				+	
					Morchellioides affinis,					+
					Morchellium giardi,					+
					Sidnyum pallidum,					+
					Polyclinum pyriforme,					+
					fungosum,				+	
					depressum,		+			
					molle,				+	
					incertum,					+
					minutum,					+
					Aplidium incrustans,				+	
					fuscum,					+
					leucophæum,					+
					crassum,		+			

[1] This column has been made 40°–65° in order that the species obtained during the "Lightning" and "Porcupine" expeditions might be included in the record.

North Latitude.					Species.	South Latitude.				
65°–40°	40°–30°	30°–20°	20°–10°	10°–0°		0°–10°	10°–20°	20°–30°	30°–40°	40°–55°
+					*Aplidium fallax*,					
+					*despectum*,					
			+		*fumigatum*,					+
					Amaroucium variabile,					+
					var. *tenerum*,					+
					globosum,					+
					complanatum,					+
					irregulare,					+
					v. *concinnum*,					+
					pallidulum,					+
					recumbens,					+
					hepaticum,					
					lævigatum,					+
					colelloides,				+	
					albidum,				+	
					nigrum,					+
					Psammaplidium spongiforme,				+	
					effrenatum,				+	
					rude,					
					subviride,				+	
					exiguum,				+	
					ovatum,		+			
					retiforme,					+
					flavum,				+	
					pyriforme,		+			
					——— (?) *ignotus*,					+
					Didemnum savignii,				+	
					aurantiacum,				+	
	+				*inerme*,					
					Leptoclinum tonga,			+		
				+	*moseleyi*,					
					speciosum,		+			
					var. *asperum*,		+		+	
					annectens,		+			
+					*tenue*,				+	+
+					v. *magnizooidium*,					
					propinquum,					+
					neglectum,					
			+		*albidum* (?),				+	
	+				var. *luteolum*,					
			+		var. *grande*,					
					subflavum,					+
	+				*jeffreysi*,					
+					*carpenteri*,					
+					*thomsoni*,					

North Latitude.					Species.	South Latitude.				
65°–40°	40°–30°	30°–20°	20°–10°	10°–0°		0°–10°	10°–20°	20°–30°	30°–40°	40°–55°
					Leptoclinum edwardsi,				+	
	+				*japonicum,*					
					jacksoni,				+	
					rubicundum,					+
					Diplosomoides molle,	+				
					Diplosoma macdonaldi,		+			
					Cœlocormus huxleyi,				+	
					Goodsiria placenta,				+	
					var. *fusca,*				+	
					pedunculata,					+
					coccinea,					+
				+	*Synstyela incrustans,*					+
					Chorizocormus reticulatus,					+
9	9	0	4	7	Total number of entries in each column.	2	9	1	25	39
Northern hemisphere, 29.					Total number of entries in each hemisphere.	Southern hemisphere, 76.				

This table brings out very forcibly—first, the great preponderance of Compound Ascidians in the southern over the northern hemisphere, there being between two and three times as many entries on the right hand side of the table as on the left, notwithstanding the fact that more than one-third of those on the latter are due to species obtained during the cruises of the "Lightning" and "Porcupine," which were confined to the northern hemisphere; and secondly, the great abundance of Compound Ascidians in the far south, the two last columns in the right hand side (30°–40° and 40°–55°, 25° in all) containing together a good deal more than half the total number of entries. Consequently, it would appear from the Challenger investigations that the Compound Ascidians, like the Simple Ascidians, attain their greatest numerical development in the southern temperate zone.

The family Botryllidæ appears to be confined to the northern hemisphere, in which, however, it has a wide range.

The Distomidæ are well represented in both hemispheres, and they extend widely both to the north and to the south of the equator. The genus *Colella* is mainly a southern form, and is only represented north of the equator by *Colella thomsoni*, from the Philippine Islands.

The Polyclinidæ, according to the Challenger investigations, is almost entirely a southern family, as it is represented by about forty species in the southern hemisphere,

and by only three in the northern. More than half the new species in this family were obtained to the south of 40° south latitude.

In the Didemnidæ, on the other hand, there is no such disproportion; the northern hemisphere shows eleven entries and the southern fifteen, and the members of the family are apparently scattered widely. The genus *Leptoclinum* is well represented in both hemispheres, and has a wider range than any other genus in the collection. It is not a markedly southern form, and in this respect it contrasts with *Amaroucium*, the next largest genus, which has nearly all its species confined to the far south.

The Challenger Diplosomidæ are from tropical seas, and the family Cœlocormidæ is only known from the southern hemisphere.

The Polystyelidæ have a wide range. Most of the Challenger species are from far south, but one (*Synstyela incrustans*) also occurs north of the equator. The species of the family which were known previously are from the north temperate zone. These, however, belong to genera distinct from the southern forms.

BATHYMETRICAL DISTRIBUTION.

In this section, as in the preceding one, the Challenger results will be treated in the same manner as that which was adopted in the First Part of this Report, in order that the conclusions arrived at in the case of the Compound Ascidians may be readily combined or compared with those given for the Simple Ascidians.[1]

The first table given below shows the range in depth of the species, genera, and families of Compound Ascidians. The names are arranged systematically, and only the extreme limits of depth at which each species has been found are given.

In the case of a few of the species the depths at which they were obtained is not known.

Family, Genus, and Species.	Range in Depth.
BOTRYLLIDÆ—	
Botrylloides tyreum,	18 fathoms.
perspicuum,	10 ,,
var. *rubicundum*,	10 ,,
nigrum,	Shallow water.
fulgurale,	530 fathoms.
Sarcobotrylloides wyvillii,	363 ,,
Polycyclus lamarcki,	363 ,,
jeffreysi,	35 ,,
DISTOMIDÆ—	
Colella pedunculata,	10–75 ,,
thomsoni,	10 ,,
gaimardi,	5–10 ,,
pulchra,	6 ,,
elongata,	30 ,,
quoyi,	25 ,,
murrayi,	120 ,,
var. *rubida*,	38 ,,
ramulosa,	245 ,,
concreta,	10–60 ,,
Distaplia vallii,	10–35 ,,

[1] See Part I. of this Report (vol. vi., 1882), p. 267.

Family, Genus, and Species.	Range in Depth.
——— (?) *clava*,	450 fathoms.
——— (?) *pyriformis*,	Shallow.
Cystodytes draschii,	400 fathoms.
philippinensis,	10 ,,
Symplegma viride,	Shallow water.
POLYCLINIDÆ—	
Pharyngodictyon mirabile,	1600 fathoms.
Tylobranchion speciosum,	10–100 ,,
Atopogaster gigantea,	55 ,,
aurantiaca,	(?) 85 ,,
informis,	.....
elongata,	55 ,,
var. *pallida*,	10–20 ,,
Morchellioides affinis,	10–60 ,,
Morchellium giardi,	20–60 ,,
Sidnyum pallidum,	50–75 ,,
Polyclinum pyriforme,	10–60 ,,
fungosum,	6–15 ,,
depressum,	3–11 ,,
molle,	600 ,,
incertum,	55 ,,
minutum,	20–60 ,,
Aplidium incrustans,	600 ,,
fuscum,	20–60 ,,
leucophæum,	10–60 ,,
crassum,	Shallow water.
fallax,	10 fathoms.
despectum,	51 ,,
fumigatum,	10–100 ,,
Amaroucium variabile,	10–100 ,,
var. *tenerum*,	10–60 ,,
globosum,	10–60 ,,
complanatum,	50–120 ,,
irregulare,	55 ,,
var. *concinnum*,	55 ,,
pallidulum,	12 ,,
recumbens,	245 ,,
hepaticum,	.....
lævigatum,	55 ,,
colelloides,	150 ,,
albidum,	38 ,,
nigrum,	28 ,,
Psammaplidium spongiforme,	7 ,,
effrenatum,	600 ,,
rude,	.....

Family, Genus, and Species.	Range in Depth.
Psammaplidium subviride,	150 fathoms.
exiguum,	98 „
ovatum,	3–11 „
retiforme,	50–120 „
flavum,	600 „
pyriforme,	8 „
——— (?) *ignotus*,	55 „
DIDEMNIDÆ—	
Didemnum savignii,	150 „
aurantiacum,	38 „
inerme,	Shallow water.
Leptoclinum tonga,	18 fathoms.
moseleyi,	10 „
speciosum,	7–20 „
var. *asperum*,	7–20 „
annectens,	Shallow water.
tenue,	175–600 fathoms.
var. *magnizooidium*,	.....
propinquum,	245 „
neglectum,	.....
albidum (?),	10–125 „
var. *luteolum* (?),	35 „
var. *grande*,	95 „
subflavum,	28 „
jeffreysi,	35 „
carpenteri,	.....
thomsoni,	.....
edwardsi,	150 „
japonicum,	50 „
(?) *jacksoni*,	6–15 „
rubicundum,	20–60 „
DIPLOSOMIDÆ—	
Diplosomoides molle,	Shallow water.
Diplosoma macdonaldi,	Shallow water.
CŒLOCORMIDÆ—	
Cœlocormus huxleyi,	600 fathoms.
POLYSTYELIDÆ—	
Goodsiria placenta,	10–20 „
var. *fusca*,	10–20 „
pedunculata,	5–10 „
coccinea,	5–70 „
Synstyela incrustans,	10–55 „
Chorizocormus reticulatus,	30 „

From this table it is a simple matter to determine the range in depth of any particular genus, *e.g.*:—

Botrylloides	.	extends from shallow water to 530 fathoms.
Colella	.	„ 5 to 245 fathoms.
Polyclinum	.	„ 3 to 600 „

The seven families of Ascidiæ Compositæ are found to have the following limits :—

The Botryllidæ range from the shore to 530 fathoms.
The Distomidæ „ „ 450 „
The Polyclinidæ „ „ 1600 „
The Didemnidæ „ „ 600 „
The Diplosomidæ are confined to shallow water.
The Cœlocormidæ have only been found at a depth of 600 fathoms.
The Polystyelidæ range from 5 to 70 fathoms.

Hence it appears that, with the exception of the Cœlocormidæ, only known from a single specimen of *Cœlocormus huxleyi* obtained off the east coast of South America, there is no family peculiar to deep water; each of the others contains some species ranging from quite shallow water downwards. Four of the families, the Botryllidæ, the Polyclinidæ, the Didemnidæ, and the Cœlocormidæ, are represented in the abyssal zone,[1] while one other, the Distomidæ, is found at very considerable depths. The remaining two, the Diplosomidæ and the Polystyelidæ, are only known from depths of less than 100 fathoms.

The Polyclinidæ is the only family which extends into water of over 1000 fathoms, and it is only represented in such depths by one species (*Pharyngodictyon mirabile*). If this species were placed in an independent family, then the limit in depth of the Polyclinidæ, as now known, would be 600 fathoms.

In the Botryllidæ, although only one species (*Botrylloides fulgurale*) is abyssal, three genera are represented at considerable depths, viz., *Botrylloides* at 530 fathoms, and *Sarcobotrylloides* and *Polycyclus* both at 363 fathoms.

In the Distomidæ there is no peculiarly deep-water genus, but four species occur at depths of over 100 fathoms, viz., *Colella murrayi*, 120 fathoms, *Colella ramulosa*, 245 fathoms, ——— (*?*) *clava*, 450 fathoms, and *Cystodytes draschii*, 400 fathoms. The other species are all shallow-water forms.

In the Polyclinidæ, *Pharyngodictyon* is the only deep-water genus, but five species of the family, belonging to four distinct genera, extend into the abyssal zone. The other members of the family are nearly all confined to shallow water.

[1] Depths of 500 fathoms and upwards.

In the Didemnidæ there is one abyssal form, *Leptoclinum tenue*, but four other species extend to depths of over 100 fathoms.

If the range of depth at which Compound Ascidians were found (from the shore down to 1600 fathoms) be divided into zones, the following results will be arrived at :—

I.—Between the shore and 50 fathoms sixty species and varieties were found, viz.:—

Botrylloides tyreum.
„ *perspicuum.*
„ „ var. *rubicundum.*
„ *nigrum.*
Polycyclus jeffreysi.
Colella pedunculata.
„ *thomsoni.*
„ *gaimardi.*
„ *pulchra.*
„ *elongata*
„ *quoyi.*
„ *murrayi*, var. *rubida.*
„ *concreta.*
Distaplia vallii.
———— (?) *pyriformis.*
Cystodytes philippinensis.
Symplegma viride.
Tylobranchion speciosum.
Atopogaster elongata, var. *pallida.*
Morchellioides affinis.
Morchellium giardi.
Polyclinum pyriforme.
„ *fungosum.*
„ *depressum.*
„ *minutum.*
Aplidium fuscum.
„ *leucophæum.*
„ *crassum.*
„ *fallax.*
„ *fumigatum.*
Amaroucium variabile.
„ „ var. *tenerum*
„ *globosum.*

Amaroucium pallidulum.
„ *albidum.*
„ *nigrum.*
Psammaplidium spongiforme.
„ *ovatum.*
„ *pyriforme.*
Didemnum aurantiacum.
„ *inerme.*
Leptoclinum tonga.
„ *moseleyi.*
„ *speciosum.*
„ „ var. *asperum.*
„ *annectens.*
„ *albidum.*
„ „ var. *luteolum.*
„ *subflavum.*
„ *jeffreysi.*
„ *jacksoni.*
„ *rubicundum.*
Diplosomoides molle.
Diplosoma macdonaldi.
Goodsiria placenta.
„ „ var. *fusca.*
„ *pedunculata.*
„ *coccinea.*
Synstyela incrustans.
Chorizocormus reticulatus.

In this list twenty-two genera and six families are represented.

II.—Between 50 fathoms and 100 fathoms thirty-one species were found, viz.:—

Colella pedunculata.
„ *concreta.*
Tylobranchion speciosum.
Atopogaster gigantea.
„ *aurantiaca.*
„ *elongata.*
Morchellioides affinis.
Morchellium giardi.
Sidnyum pallidum.

Polyclinum pyriforme.
„ *incertum.*
„ *minutum.*
Aplidium fuscum.
„ *leucophæum.*
„ *despectum*
„ *fumigatum.*
Amaroucium variabile.
„ „ var. *tenerum.*
„ *globosum.*
„ *complanatum.*
„ *irregulare.*
„ „ var. *concinnum.*
„ *lævigatum.*
Psammaplidium exiguum.
„ *retiforme.*
———— (?) *ignotus.*
Leptoclinum albidum, var. *grande.*
„ *japonicum.*
„ *rubicundum.*
Goodsiria coccinea.
Synstyela incrustans.

In this list fourteen genera and four families are represented.

III.—Between 100 fathoms and 250 fathoms twelve species were found, viz.:—

Colella murrayi.
„ *ramulosa.*
Amaroucium complanatum.
„ *recumbens.*
„ *colelloides*
Psammaplidium subviride.
„ *retiforme.*
Didemnum savignii.
Leptoclinum tenue.
„ *propinquum.*
„ *albidum.*
„ *edwardsi.*

In this list five genera and three families are represented.

IV.—Between 250 fathoms and 500 fathoms four species were found, viz.:—

Sarcobotrylloides wyvillii.
Polycyclus lamarcki.
——— (?) *clava.*
Cystodytes draschii.

In this list four genera and two families are represented.

V.—Between 500 fathoms and 1000 fathoms seven species were found, viz.:—

Botrylloides fulgurale.
Polyclinum molle.
Aplidium incrustans.
Psammaplidium effrenatum.
„ *flavum.*
Leptoclinum tenue.
Cœlocormus huxleyi.

In this list six genera and four families are represented.

VI.—Between 1000 fathoms and 2000 fathoms one species was found, viz.:—

Pharyngodictyon mirabile.

From these lists it appears that Compound Ascidians, like Simple Ascidians, are much more common in shallow than in deep water, that only eight species extend into the abyssal zone, only one species to depths over 1000 fathoms, and that more than half the total number of species are found living at depths between 1 and 50 fathoms.

These lists, however, do not accurately represnt ethe whole state of affairs, as they do not take into account the greater facilities for collecting in shallow water, nor yet the relative numbers of the deep and the shallow water dredgings performed during the voyage.

Hence the following list, showing the number of dredgings taken by the Challenger Expedition in the different zones, and the proportion of them at which Compound Ascidians were found, is necessary in order to give a more complete idea of the bathymetrical distribution of the collection :—

In 32 dredgings at from 0–50 fathoms, Ascidiæ Compositæ occurred 16 times,[1] or at 50 per cent. of the Stations.								
„ 51	„	50–500	„	„	14	„	27	„ „
„ 23	„	500–1000	„	„	1	„	4	„ „
„ 94	„	1000–2000	„	„	1	„	1	„ „

The column of percentages brings out very clearly that the Compound Ascidians are mainly a shallow-water group, that they are abundant around coasts in a few fathoms of

[1] Including a few localities which were not Stations, such as Bermuda, Bahia, Simon's Bay, Port Jackson, &c.

water, and that they rapidly decrease in numbers as greater and greater depths are reached. They are not so well represented in the abyssal zone as the Simple Ascidians are, and, so far as is known, they do not extend to as great a depth. Twenty species of Simple Ascidians were found in the abyssal zone, and seven[1] species occurred at depths between 2000 and 3000 fathoms.

Just as in the case of the Ascidiæ Simplices, it does not seem possible to establish any relation between the occurrence of Compound Ascidians and the nature of the bottom. The shallow water forms are chiefly found on rocky and stony shores, and in many cases are attached to Zoophytes, Sponges, and Algæ. Those from deep water are found living on various kinds of deposit, including "volcanic mud," "green sand," "Globigerina ooze," "blue mud," "Diatom ooze," "rock," &c.

The temperature of the water appears also to have little influence upon the distribution of the Ascidiæ Compositæ, as the bottom temperatures at their localities show a considerable range, extending from a little above freezing point (34·2° F.) upwards to 71° F.

[1] To these numbers must be added the additional Simple Ascidians described i Appendix A, below.

SUMMARY AND GENERAL REMARKS.

The present section will consist of a brief summary of the chief additions made by the Challenger Expedition to our knowledge of the Compound Ascidians, along with a discussion, where necessary, of any structural points of interest or novelty. An account of the probable phylogeny of the group, and of its relations to the other Tunicata, will conclude this part of the Report. The remarks upon the different genera and species in the following pages are arranged in the same order in which the families were treated in the preceding systematic part of the work, beginning with the Botryllidæ and ending with the Polystyelidæ. This, as was pointed out in the Introduction, is a somewhat artificial arrangement. The natural relations of the families will be discussed further on, in connection with the phylogeny of the group.

The family Botryllidæ is represented in the collections by seven species and a well-marked variety, all new to science. It is remarkable that all the Challenger specimens belong to the genus *Botrylloides*, while *Botryllus*, which is so common on the coasts of north-west Europe, was not obtained in any of the expeditions. The Botryllidæ were all collected to the north of the equator, and the only tropical region in which they occurred was the Philippine Islands. No new genus has been required in this family. The name of the new species described on page 41 as *Botrylloides purpureum* I now change to *Botrylloides tyreum*, as the specific name *purpureum* was pre-occupied by a distinct species.[1]

The family Distomidæ is represented by fifteen species and a well-marked variety. It is a large group, including von Drasche's family Chondrostachyidæ, and a series of new forms, for which the genus *Colella* has been founded (see p. 72). This genus is allied to *Distaplia*, Della Valle, and to *Oxycorynia*, von Drasche; it contains nine species and a variety, all new to science with the exception of *Colella pedunculata*, described in 1834 under the name of *Aplidium pedunculatum* by Quoy and Gaimard. Most of these forms have the test of the lower part of the colony remarkably modified, so as to form a well-

[1] See von Drasche, Die Synascidien, p. 15.

marked peduncle, upon which the remainder of the colony (the "head"), containing the Ascidiozooids, is borne. Gemmation is effected by means of the vascular prolongations from the Ascidiozooids which penetrate the peduncle, and the history of the colony in *Colella* appears to be as follows:—The first Ascidiozooid produced by the fixing of the tailed larva forms the young test which grows rapidly at the side next the point of attachment, thus raising the Ascidiozooid upwards on a short stalk. A vascular prolongation from the posterior end of the body of the Ascidiozooid now grows downwards into the gradually increasing peduncle, and after a time forms one or more young buds, which become cut off from the vascular prolongation and lie in the test of the peduncle. These buds are now carried upwards by the constant growth of the peduncle at its base, so that eventually, when they are fully developed, they have reached what is now the upper part of the peduncle, and take their places in the "head" next to the Ascidiozooid from which they were originally produced. Meanwhile the vascular prolongation from that Ascidiozooid has been growing downwards still further through the peduncle and producing new buds. The young Ascidiozooids formed from the first buds in their turn produce vascular prolongations, and then buds in the peduncle. As the Ascidiozooids in the upper part of the colony or "head" grow older they produce true reproductive organs, and embryos are formed. These undergo their development in the incubatory pouch, a large diverticulum from the dorsal edge of the peribranchial cavity. The oldest Ascidiozooids and embryos in the colony finally reach the upper end, die, and decay, the fully developed tailed larvæ in the incubatory pouches being set free to swim away and found new colonies. From this account it is obvious that the test grows at the lower end of the colony, and is constantly dying and wasting away at the upper end, while each Ascidiozooid in the course of its life traverses the whole length of the colony (see p. 93).

On account of the large size of the Ascidiozooids in two of the species of *Colella*, of which there were duplicates in the collection, these forms were chosen for a detailed examination of the anatomy and histology (see pp. 74 and 94).

The pigmentation of some of the species of *Colella* is very striking. In *Colella thomsoni* the body of the Ascidiozooid is coloured of a deep indigo-blue, while in *Colella murrayi* the test contains great masses of opaque white pigment cells. The allied genus *Distaplia* also shows vivid pigmentation. *Distaplia vallii* is coloured by red, opaque white, and dark violet pigment cells.

Two new species were found belonging to *Cystodytes*, a genus characterised by the possession of discoid calcareous spicules in the test around the bodies of the Ascidiozooids. These spicules seem to be enclosed in membranous capsules, containing nuclei, and this fact, taken along with some observations made upon the relations of the spicules to the test in *Leptoclinum tonga* (see p. 269), seems to point to the origin of these calcareous spicules from groups of modified test cells, the remains of which persist around the spicule in the form of a delicate membrane.

A new genus, *Symplegma* (p. 144), has been formed for a remarkable colony obtained at Bermuda. This form differs from all the other Distomidæ in having internal longitudinal bars in the branchial sac, but it is really very doubtful whether the genus ought to be placed in this family. I am rather inclined to suspect that *Symplegma* will turn out to be an aberrant form allied to the Botryllidæ (see p. 397).

The large family Polyclinidæ is represented in the Challenger collection by forty-three species and at least three well-marked varieties. One species (*Aplidium fallax*) was previously known, the rest are all new to science. Ten genera are represented, and five of these (*Pharyngodictyon*, *Tylobranchion*, *Atopogaster*, *Morchellioides*, and *Psammaplidium*) are new groups (see p. 151) formed for the reception of Challenger species.

The most remarkable form in the family is undoubtedly *Pharyngodictyon mirabile* (see p. 153), in which the branchial sac is in the curious degenerate condition found in *Culeolus* amongst Simple Ascidians. The internal longitudinal bars and the transverse vessels form a square-meshed network, which is not broken up into stigmata, as the system of fine longitudinal vessels seems to be entirely absent. This peculiar condition of the branchial sac seems to be associated with the abyssal zone, as it has apparently been evolved independently in at least four different groups of deep-sea Ascidians, viz., *Culeolus*, *Fungulus*, *Bathyoncus*, and *Pharyngodictyon*, while it has not been found in any forms from shallow water.

In *Pharyngodictyon* then, internal longitudinal bars are present in the branchial sac, while they are absent in all the other Polyclinidæ. In *Tylobranchion speciosum*, however, the transverse vessels bear curious papillæ (see Pl. XXII. fig. 7), which are probably rudimentary connecting ducts which have lost their proper function, as there are no internal longitudinal bars present to support them, but which have not yet disappeared. The branchial sac of *Tylobranchion speciosum* is therefore in an intermediate condition of degeneration between that of *Pharyngodictyon mirabile* and that of the other Polyclinidæ (see phylogeny of the group, p. 390).

The genus *Atopogaster* includes some new species of large size which have the stomach-wall more or less transversely folded, an unusual condition in Ascidians.

The curious group of species characterised by that irregularly thickened condition of the stomach-wall called areolated by Giard, is represented in the collection by three forms all new to science, viz., *Morchellioides affinis*, *Morchellium giardi*, and *Sidnyum pallidum*. The first of them (see p. 177) has eight lobes around the branchial aperture, while in most of the Compound Ascidians the branchial apertures are always six-lobed.

The remaining new genus, *Psammaplidium*, is closely allied to *Aplidium*, but has the test strengthened by imbedded sand-grains (see p. 237 and Pl. XXXI. fig. 9). It contains nine new species, all from the southern hemisphere.

The Polyclinidæ as a family are very widely distributed, but the majority of the Challenger species are from the far south.

The family Didemnidæ is represented by nineteen species and at least four varieties. One of the species (*Leptoclinum albidum*) was previously known, the other forms are all new to science. Nearly all of these species are opaque white or grey; a few, however, are pigmented. *Didemnum savignii* is a chocolate-brown, *Didemnum aurantiacum* is orange, and *Leptoclinum rubicundum* is of a rust red colour. The Didemnidæ have a world-wide distribution.

Some of the Challenger species of *Leptoclinum* form remarkably calcareous colonies, the spicules being very numerous and densely crowded in the test (see *Leptoclinum moseleyi*, p. 272). The relation of these calcareous spicules to the test matrix and cells is discussed in the case of *Leptoclinum tonga* (p. 269).

Two new species belonging to the interesting family Diplosomidæ were obtained during the Challenger Expedition. For one of them, along with a previously described species of von Drasche's (*Diplosoma pseudoleptoclinum*), I have founded the new genus *Diplosomoides*.

Probably the single colony of *Cœlocormus huxleyi*, which was obtained from a depth of 600 fathoms off the east coast of South America, is the most remarkable and important Compound Ascidian in the collection. It is an unattached massive colony, with an axial cavity. The branchial apertures of the Ascidiozooids are five-lobed, a condition not found in any other Ascidians. There are a few calcareous spicules in the upper layer of the colony, like those of the Didemnidæ; and the male reproductive organs are in an intermediate condition between those of the Distomidæ and of the Didemnidæ. On account of these and other remarkable peculiarities (see p. 317), I have found it necessary to establish a new family, the Cœlocormidæ, occupying an intermediate position between the Diplosomidæ and the Pyrosomidæ (see also under Phylogeny, p. 394).

The Polystyelidæ, a group which I have raised to the rank of a family, has important relations with the Cynthiidæ amongst Simple Ascidians (see under Phylogeny, p. 398), and is well represented in the Challenger collection. This family was only known previously from a few species obtained on the shores of north-west Europe, and a single species (*Goodsiria coccinea*) from the Strait of Magellan. To these the Challenger investigations have added four new species and a variety.

One new genus has been formed for *Chorizocormus reticulatus*, a species from Kerguelen Island which exhibits particularly well the gradual union of Ascidiozooids to form a colony (see p. 346).

The relations of this family to the Simple Ascidians on the one hand, and to the Botryllidæ on the other, are discussed in connection with the phylogeny of the Compound Ascidians further on (p. 398).

The new Challenger Polystyelidæ are nearly all from southern latitudes. Some of them form very large colonies, and the Ascidiozooids are much larger than in the case of most Compound Ascidians.

Although Compound Ascidians are probably all hermaphrodite if the entire life of the Ascidiozooid be taken into consideration, still it very often happens that particular Ascidiozooids when examined are found to have the reproductive organs of only one sex developed. This was the case in a number of the Challenger colonies, and in many of these cases I have been able to make out that the female organs develop first in the young Ascidiozooid, and then, after the ova have attained maturity and escaped, the male system begins to form, and is found in a fully developed condition in the adult Ascidiozooid only. I have found this protogynous arrangement in the following species, and it probably exists in many more:—

Botryllidæ.

Botrylloides tyreum.
Botrylloides fulgurale.
Sarcobotrylloides wyvillii.
Polycyclus jeffreysi.

Distomidæ.

Colella pedunculata.
Colella thomsoni.
Colella gaimardi.
Colella quoyi.
Colella murrayi.
Colella ramulosa.

In a number of the Polyclinidæ and Didemnidæ also, only male reproductive organs were found in the Ascidiozooids examined, but in such cases it is not certain that the female system occurs only in the younger Ascidiozooids.

In *Cœlocormus huxleyi*, on the other hand, a protandrous condition appears to exist (see p. 322), the male organs developing first, and being succeeded later on in the life of the Ascidiozooid by the female system.

In some of the Polystyelidæ the polycarps are unisexual, and the male and female polycarps differ in appearance. In one species, *Goodsiria pedunculata*, only female polycarps were found in the Ascidiozooids examined, but whether this is a case of protogyny or protandry is not known. Possibly it may be due to a unisexual condition of the Ascidiozooids. It would not be surprising to find that in a group where the polycarps have become differentiated and heteromorphic, one or more species were unisexual.

Tailed larvæ were found in a number of the colonies examined, either in the peribranchial cavities of the Ascidiozooids or in a specially formed incubatory pouch (see *Colella pedunculata*, p. 89), or merely imbedded in the common test of the colony.

The following list, giving the species in which larvæ occurred, the dates when the

specimens were found, and the localities, may be of importance in connection with the determination of the times of the year at which Ascidians reproduce in different parts of the world.

TABLE SHOWING SPECIES OF COMPOUND ASCIDIANS IN WHICH LARVÆ WERE FOUND.

Species.	Locality.	Date.
Botrylloides nigrum,	Bermuda.	...
Sarcobotrylloides wyvillii,	Faroë Channel.	August.
Colella pedunculata,	Kerguelen Island and Strait of Magellan.	January and February.
Colella thomsoni,	Philippine Islands.	January 30.
Colella gaimardi,	Falkland Islands.	January 27.
Colella pulchra,	Torres Strait.	September 9.
Colella concreta,	Kerguelen Island.	January.
Distaplia vallii,	(1) Mediterranean, (2) Philippine Islands.	(1) August, (2) January 30.
———— (?) *pyriformis*,	Kerguelen Island.	January.
Cystodytes draschii,	Off Brazil.	September 10.
Polyclinum fungosum,	Port Jackson.	April.
Polyclinum molle,	East coast of Patagonia.	February 14.
Aplidium fallax,	Loch Foyle.	Summer.
Aplidium despectum,	Off Nova Scotia.	May 8.
Amaroucium pallidulum,	Falkland Islands.	January 27.
Amaroucium recumbens,	Strait of Magellan.	January 11.
Amaroucium colelloides,	South of the Cape of Good Hope.	December 18.
Psammaplidium exiguum,	Off Cape of Good Hope.	December 17.
Psammaplidium retiforme,	Kerguelen Island.	January 29.
Didemnum aurantiacum,	Bass' Strait.	April 2.
Leptoclinum tenue,	Patagonia.	January.
Leptoclinum albidum, var. *luteolum*,	Morocco.	August 5.
Leptoclinum jacksoni,	Port Jackson.	April.
Cœlocormus huxleyi,	East coast of Patagonia.	February 14.
Goodsiria placenta,	Simon's Bay.	December.
Goodsiria placenta, var. *fusca*,	Simon's Bay.	December.
Synstyela incrustans,	Strait of Magellan.	January 20.

Buds in various stages of development occurred in a number of species belonging to different families. The process of gemmation appears to be usually effected by means of vascular appendages or prolongations from the body of the parent Ascidiozooid. This process has been long known in the case of the Clavelinidæ, and has been more than once described in certain Botryllidæ (see *Sarcobotrylloides wyvillii*, p. 59); and I have been able to show that it also occurs in the genus *Colella* (p. 90).

In the Polyclinidæ the buds are formed from the post-abdomen, which, however, seems to be merely the enlarged upper part of a vascular appendage into which the reproductive organs have extended. The small knobs found on the end of the post-abdomen of some species of Polyclinidæ (*e.g.*, *Polyclinum molle*, p. 196, and *Amaroucium globosum*, p. 221) are, I believe, the rudimentary terminations of the modified vascular

appendage. In *Morchellioides affinis* (see p. 177) the post-abdomen terminates in distinct vessels which run for a short distance through the test and terminate in bulbs (see Pl. XXIV. fig. 17, *v.ap.*).

In the Botryllidæ the system of branched and anastomosing vessels in the test has become greatly enlarged, and probably forms an accessory organ of respiration.[1] The explanation of this system being so much more developed in the Botryllidæ than in the other Compound Ascidians is to be found in the evolution of the group. The Botryllidæ have probably sprung from the Simple Ascidians after these had acquired well-marked systems of respiratory vessels in their tests, while most of the other Compound Ascidians originated at an earlier point, while the vessels were still in the form of gemmiparous stolons (see under Phylogeny, below).

In those Distomidæ where the colony has become pedunculated (*e.g.*, *Colella*) the young Ascidiozooids are added at the base of the head, and those at the summit are the oldest; but in one species of the Polystyelidæ, *Goodsiria placenta*, the older Ascidiozooids seem to be next the peduncle, while the younger ones are at the upper end of the colony. In *Cœlocormus huxleyi* also the older Ascidiozooids seem to be in what must be regarded as the basal part of the colony. In all these cases the relative positions of the Ascidiozooids, and, to a certain extent, the shape of the colony, depend upon the method and the region in which gemmation is carried on.

Phylogeny.

The detailed investigation of the structure of the various groups of Simple and Compound Ascidians, and the consideration of their relationships, have gradually led me to the conclusion that the Ascidiæ Compositæ are polyphyletic in origin, being composed of several branches which have arisen from the Simple Ascidians at different times. Consequently, in order to explain the probable phylogeny of the Compound Ascidians, it will be necessary to refer to that of the Simple Ascidians discussed at the end of the first part of this Report.[2]

The ancestral Simple Ascidian there described, and which I regard as being also the common ancestor of all the Compound Ascidians, was probably derived from the Proto-Tunicata[3] after the separation of the Proto-Thaliacea and the primitive Appendiculariidæ (see fig. 11, p. 388). It was the first fixed Ascidian—the ancestral Tunicates, and the primitive Appendiculariidæ, Salpidæ, and Doliolidæ derived from them being all free

[1] See Herdman, On a New Organ of Respiration in the Tunicata, *Proc. Lit. and Phil. Soc. Liverpool*, vol. xxxix. p. 39, 1884–85.

[2] In vol. vi., 1882, part xviii. p. 285.

[3] For my views as to the origin of the Proto-Tunicata and their branches see A Phylogenetic Classification of Animals, Macmillan, 1885. A more detailed account of the probable phylogeny of the Tunicata, and of the relations of the Thaliacea to the other groups, will be given in the third and concluding part of this Report.

swimming—and the changes by which it was produced from the Appendicularia-like Proto-Tunicate were probably much the same series of degenerations of certain organs

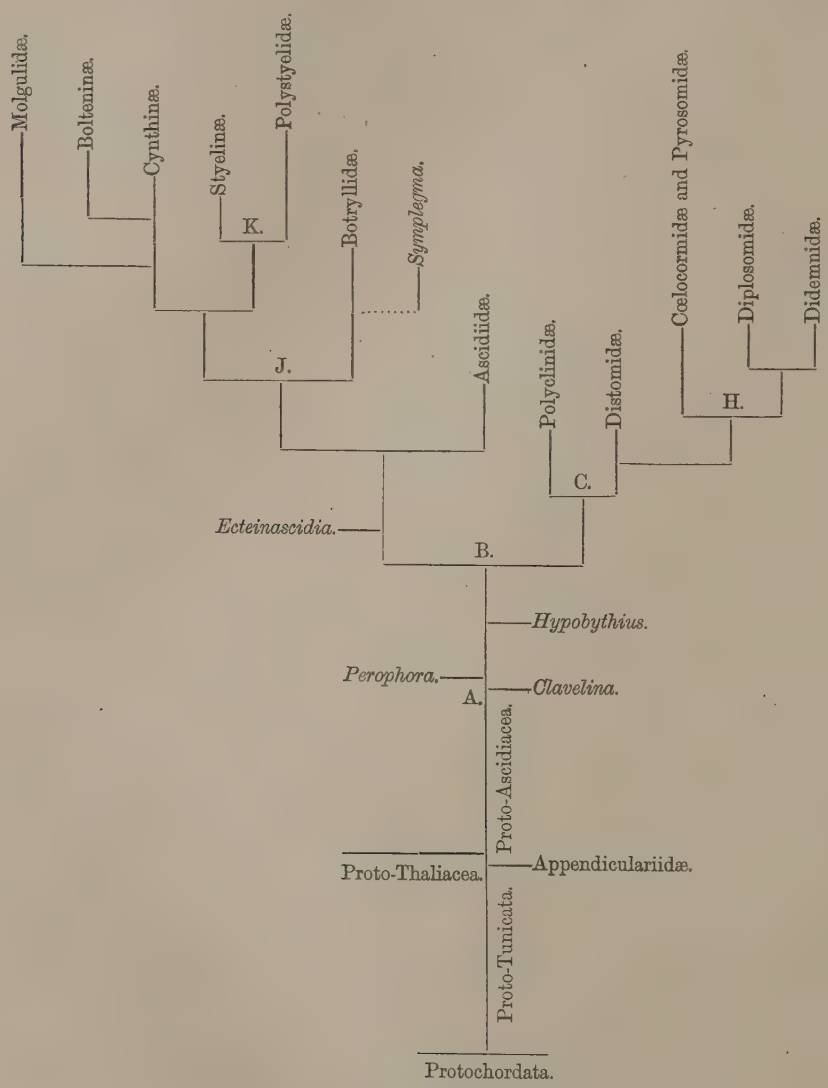


FIG. 11.—Diagram illustrating the phylogeny of the Tunicata.

and differentiation of others which are found taking place at the present day when the free-swimming tailed larva passes into the young Ascidian. The ancestors in which these changes took place, and which may be called Proto-Ascidiacea, are represented in

the accompanying diagram (fig. 11) by the line stretching from the splitting point of the Proto-Tunicata to the most recent common ancestor of Simple and Compound Ascidians (A. in diagram).

This latter form was probably something like a *Clavelina* without a peduncle. It was attached by the posterior end of the body, and was elongated antero-posteriorly. The branchial aperture was at the upper end, and the atrial far forward on the dorsal edge, and both were circular and without lobes. The branchial sac was not very large, and consequently the greater part of the alimentary canal lay posterior to it. No folds were present in the branchial sac, and the stigmata were straight. The tentacles were simple. Finally, by reproducing by gemmation, small colonies were produced. The buds were probably formed as simple outgrowths (containing some cells derived from the endoderm of the parent covered by a prolongation of the body-wall) from the posterior end of the body.

From this form (A. in diagram, fig. 11) several lines diverged. One led to the genus *Clavelina*, in which little change has taken place. The body has become elongated, and more or less pedunculated, while the buds have come to be produced on stolons which are prolongations of the body-wall of the parent Ascidiozooid covered by a layer of test and containing blood sinuses. A second line of descent, starting from A., has produced the genus *Perophora*, in which the body has become shortened antero-posteriorly, so that the alimentary canal has come to lie alongside the branchial sac. The third diverging line from A. is that representing the ancestors of the remaining Simple and Compound Ascidians. In these forms the branchial sac became complicated by the addition of internal longitudinal bars which were not previously present. The genus *Ecteinascidia*[1] is closely related to these ancestral forms.

At about this point (B. in fig. 11) the line split into two great series, the one leading to the more typical Compound Ascidians (the Polyclinidæ, the Distomidæ, &c.) and to *Pyrosoma*, and the other giving rise to the typical Simple Ascidians, and to the Botryllidæ and the Polystyelidæ. The first of these two important branches soon divided (at C. in fig. 11) into two lines of descent; the one leading to the Polyclinidæ, and the other through the Distomidæ to the Didemnidæ, the Diplosomidæ, the Cœlocormidæ, and finally the Pyrosomidæ. In both of these lines, and in their common ancestors from the point B. onwards, the power of reproducing by gemmation was retained and even increased, and the members of the resulting colonies became more closely united with one another than is the case in *Clavelina* and allied forms.

The line which leads from C. to the existing Polyclinidæ must have been occupied by a series of forms in which the body of the Ascidiozooid became more and more elongated antero-posteriorly, and finally divided more or less distinctly into three regions, the

[1] See Part I. of this Report (vol. vi., 1882), p. 239; and Sluiter, Ueber einige einfachen Ascidien, &c., Natuurkund. Tijdsch. v. Nederland. Indie, Bd. xlv. p. 160, 1885.

thorax, the abdomen, and the post-abdomen. Large colonies were formed, and the Ascidiozooids (produced by gemmation from the post-abdomen) composing the colony were so closely placed that their tests became united to form a continuous investing mass. On account of several young Ascidiozooids being usually produced from a single older Ascidiozooid in the colony, a more or less regular grouping into systems naturally took place, and then the atrial apertures of the various Ascidiozooids in a system coalesced to

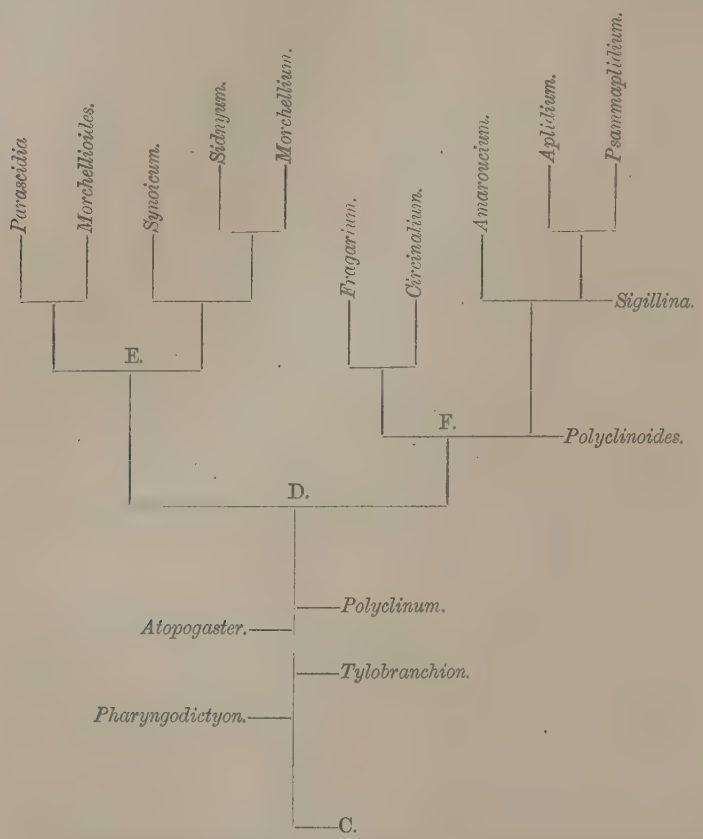


FIG. 12.—Diagram illustrating the phylogeny of the Polyclinidæ. C. indicates the point where the ancestral Polyclinidæ and Distomidæ diverged.

form a centrally placed common cloacal aperture. The branchial sac also underwent a gradual degeneration, resulting in the complete disappearance of the system of internal longitudinal bars inherited from the ancestral forms at B. (see fig. 11).

The central axis of the Polyclinidæ, extending from C. to D. (see fig. 12), was composed of a series of ancestral forms in which these and some other less important changes were gradually being effected, but from this axis a few short side branches were given off at

different periods. First, not very far from the point C. (see fig. 12), a line of descent diverged leading to the remarkable deep-sea genus *Pharyngodictyon* (see p. 153). The ancestors of this form must have diverged from the axis of the Polyclinidæ, while internal longitudinal bars were still present in the branchial sac, since these vessels (according to the interpretation of the structure given above, p. 155) are now present in *Pharyngodictyon*. In this side branch leading to *Pharyngodictyon*, however, a remarkable degeneration of the branchial sac took place, resulting in the total suppression of the system of fine interstigmatic vessels.

The second side branch from the Polyclinidæ, that leading to the genus *Tylobranchion*, appears to have left the main axis just about the point where the internal longitudinal bars in the branchial sac were disappearing, as *Tylobranchion* now shows no internal longitudinal bars, but possesses a system of papillæ which there is reason to believe are rudimentary connecting ducts, and which sometimes give off projections resembling the rudiments of internal longitudinal bars found attached to the free ends of the connecting ducts in some Simple Ascidians (see p. 161). *Pharyngodictyon* and *Tylobranchion* then, if the structure of their branchial sacs has been rightly interpreted, furnish us with valuable clues to the process of degeneration which went on in the ancestral Polyclinidæ.

The genus *Atopogaster*, which may be placed upon a third short twig given off from the axis of the Polyclinidæ (see fig. 12), differs very slightly from typical members of the family. The only modification of importance which occurs in this genus is in the structure of the stomach. The wall of this organ is thrown into a series of more or less distinct transverse folds, a condition never found in the other genera of the family.

The last side branch from the axis previous to its division into two at D. is the line leading to the genus *Polyclinum*, characterised by its smooth-walled stomach, its twisted intestine, and its laterally placed post-abdomen (see p. 186). It is a little difficult to determine the relations between *Atopogaster* and *Polyclinum*. In all probability the stomach in the ancestral Polyclinidæ was smooth-walled, while in all the higher forms of the family it is irregularly thickened either by the formation of a number of short cæca, or by being thrown into longitudinal folds. The first of these conditions is probably derived from the last, consequently the ancestor occupying the point D. (see fig. 12) had a longitudinally folded stomach-wall. Possibly *Atopogaster* diverged from the axis at the period when the tendency towards the formation of a ridged or thickened stomach-wall was being developed, and then after its separation the folds became formed more or less transversely in place of longitudinally. The line leading to *Polyclinum* probably diverged from very much the same point, and then the incipient folds in the stomach-wall were lost, and the other peculiarities of the genus acquired. *Polyclinum* cannot well be a more primitive form derived from the axis at a point before the formation of a thickened stomach-wall, as it shows no traces of internal longitudinal folds in its branchial sac, and

besides agrees with *Atopogaster* and the genera above it in most of the other points in its structure.

At the point indicated by D. in the diagram (fig. 12) the axis of the Polyclinidæ divided into two lines of descent, the one leading to an ancestral form in which the stomach-wall was areolated (see p. 177), while the second leads to a form F. in which the stomach-wall is thrown into well-marked longitudinal folds. The short cæca in the areolated condition are probably formed by the breaking up of longitudinal folds, since in *Morchellioides affinis*, a form derived from E., the cæca in the stomach-wall are distinctly arranged in longitudinal rows (see p. 179).

At the point E. two lines of descent were formed, in one of which the branchial aperture of the Ascidiozooid became eight-lobed, while in the other it remained six-lobed, the condition in which it is found in most Compound Ascidians. The ancestors with eight-lobed branchial apertures gave rise (see fig. 12) to the genera *Parascidia* and *Morchellioides* (see p. 177); while the other line of descent has split up into *Synoicum* and the closely allied forms *Sidnyum* and *Morchellium*.

The modification of the branchial aperture seen in *Parascidia* and *Morchellioides* is also found in some of the descendants of F. These forms, characterised by an eight-lobed branchial aperture, have given rise to the genera *Fragarium* and *Circinalium*, and the modification has apparently been formed independently in this branch, since both of these genera have well-marked longitudinal folds in the stomach-wall. The other line of descent derived from F. (see fig. 12) has given rise to the closely allied genera *Aplidium* and *Amaroucium*, which may be regarded as typical Polyclinidæ, and some closely related forms. The genus *Polyclinoides* was probably derived from a side branch between F. and the ancestral form of *Amaroucium*. *Sigillina* seems to be an offshoot from the ancestors of *Aplidium*. *Psammaplidium* is an interesting form also derived from the old and well-known genus *Aplidium*, by a modification of the test, which has acquired the property of taking up and growing over sand-grains and other foreign bodies, so that they become a part of the investing mass (see p. 237).

The second line leading from the point C. (in fig. 11, p. 388) gave rise first to the main axis of the Distomidæ (see fig. 13), and here, just as in the case of the early Polyclinidæ, a series of changes must have taken place, resulting in the formation of large colonies in which the Ascidiozooids were more or less completely imbedded in a common investing mass formed by the fusion of their tests. The union of the atrial apertures to form common cloacal cavities apparently did not take place so soon as in the case of the Polyclinidæ, as in many of the Distomidæ the atrial apertures of the Ascidiozooids are still found opening independently on the exterior of the colony.

The line leading from the point C. (fig. 13) to the early Distomidæ gives off a short side branch to the genus *Diazona*. This remarkable form, although not situated upon the main axis, is probably the nearest form now known to the common ancestor C.

which gave rise to most of the Compound Ascidians. *Diazona* diverged from the main line before the Ascidiozooids became completely imbedded in the common test, and just before the suppression of the internal longitudinal bars in the branchial sac took place, as these vessels are still present in *Diazona*, although absent in *Chondrostachys*, the next genus which left the main axis (see fig. 13). In the line leading to *Chondrostachys* the basal part of the colony became enlarged and prolonged to form

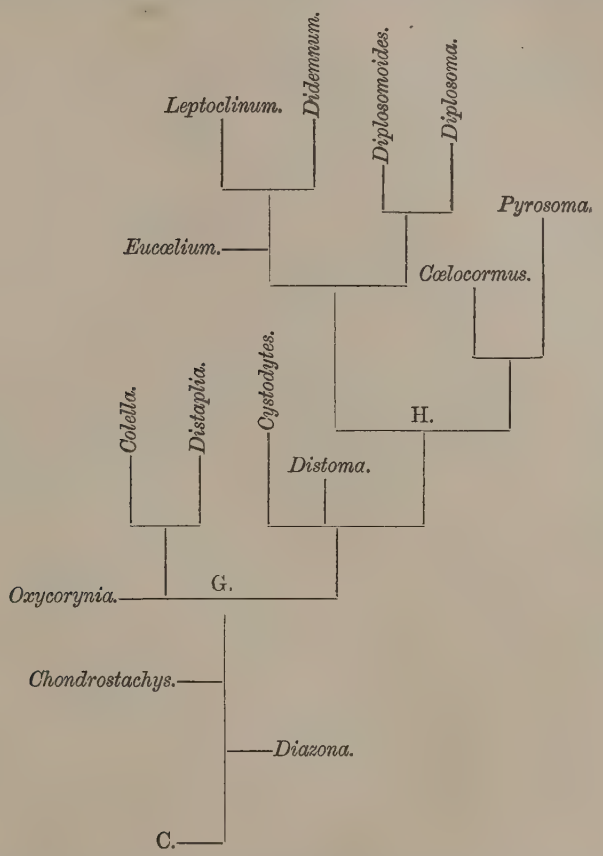


FIG. 13.—Diagram illustrating the phylogeny of the Distomidæ, Cœlocormidæ, Pyrosomidæ, Diplosomidæ, and Didemnidæ. C. indicates the point where the ancestral Polyclinidæ and Distomidæ diverged.

a peduncle, supporting the upper part in which the Ascidiozooids are placed. As in the case of *Diazona*, the Ascidiozooids are not completely imbedded in the test, but have their anterior ends partially free. In all the forms above this, however (see fig. 13), a true colony is formed by the complete union of the tests, so as to bury all the Ascidiozooids in a common investing mass.

At the point G. the main axis of the Distomidæ divided into two lines of descent:

a smaller branch leading to the genera *Oxycorynia*, *Colella*, and *Distaplia*, and a more important one, which has given rise to all the remaining forms (see fig. 13). In the ancestral forms of *Oxycorynia*, as in those of *Chondrostachys*, a peduncle has been formed, while the upper part of the colony forms an enlarged mass, the head, in which the short-bodied Ascidiozooids are imbedded.

The Ascidiozooids probably underwent very little change in form after they diverged from the ancestral Polyclinidæ at the point C. (fig. 11), and no antero-posterior elongation like that of the Polyclinidæ has taken place. In the genera *Colella* and *Distaplia* a remarkable modification of the peribranchial cavity has been effected, resulting in the formation of a large incubatory pouch in which the embryos undergo their development (see p. 89).

The chief branch springing from the point G. (fig. 13) gave rise, with very little change, to the well-known genus *Distoma*, and the allied form *Cystodytes*. This latter genus is similar to *Distoma* in most respects, but differs from it in having a remarkably modified test, in which discoid calcareous spicules are produced (see p. 135).

From the ancestors of *Distoma* a series of forms arose in which, while the general characters of the Distomidæ were preserved, some important changes were effected in the test and in the reproductive organs. The test cells acquired the property of producing spherical or stellate calcareous spicules, while the vas deferens assumed gradually the spirally coiled form which is so characteristic of the Didemnidæ (see p. 254). This ancestral line divided at the point H. into two branches, one leading with comparatively little change to the Didemnidæ and the Diplosomidæ, and the other producing the remarkable *Cœlocormus*, and eventually *Pyrosoma* (see fig. 13). In this second line diverging from H. the ancestral condition of the male reproductive organs found in the Distomidæ was retained, along with the partially coiled arrangement of the vas deferens which was present in H., and which afterwards became emphasised in the Didemnidæ. At the same time the colony became detached, and its upper surface sank in so as to produce an axial cavity, the lining of which is really morphologically a part of the outer surface of the colony (see p. 318), thus giving rise to the genus *Cœlocormus* (fig. 14, B).

The value of *Cœlocormus* as a transition form between the ordinary Compound Ascidian colony, such as a species of *Distoma* (fig. 14, A), and the pelagic *Pyrosoma* (fig. 14, C) has already been pointed out in the systematic part of this Report (see p. 319). *Pyrosoma* has probably descended from an ancestral form, allied to *Cœlocormus*, by slight changes in shape, resulting in the formation of an elongated hollow cylinder, and by a modification in the relations of the Ascidiozooids whereby they came to open independently into the large axial cavity, which is thus virtually converted into a huge common cloacal cavity (see fig. 14, C.). The colony is free-swimming, and the Ascidiozooids have acquired light-producing organs placed laterally on their anterior ends in the positions occupied by the masses of pigment cells in *Polycyclus jeffreysi* (see p. 68).

Pyrosoma, then, may be regarded as a highly modified form derived from the ancestral Didemnidæ (H. in fig. 13), and much more closely allied to the ordinary Compound Ascidians, such as the Distomidæ and the Polyclinidæ, than to the other pelagic Tunicates, such as a colony of Salpæ.

The ancestral Didemnidæ which were derived from the point H. divided into two series, those leading to the Didemnidæ proper, and those which have given rise to the Diplosomidæ. From the former, near the point of division, arose the side branch leading to the genus *Eucœlium*, where the number of rows of stigmata in the branchial sac is greater than three or four, thus resembling most of the ancestral Distomidæ, from which the Didemnidæ were derived. In the family Didemnidæ the property of producing calcareous spicules in the test has reached its greatest development. Similar spicules (apparently

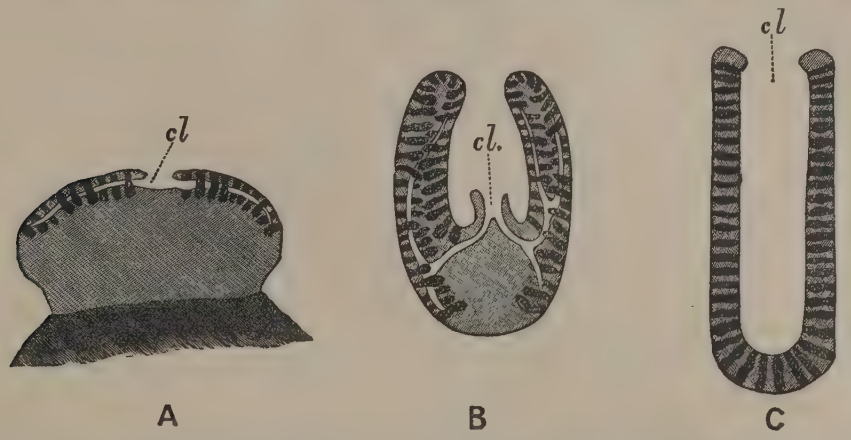


FIG. 14.—Diagrams showing the relations between—A, a typical Compound Ascidian; B, *Cœlocormus;* C, *Pyrosoma*. In all cases the colonies are represented in longitudinal section, and *cl.* indicates the opening of the common cloacal cavity.

in all cases formed by modified test cells, see p. 271) are found also in the Diplosomidæ and in the Cœlocormidæ, and a somewhat different form of spicule occurs in the genus *Cystodytes*, consequently it is possible that the tendency towards the formation of calcareous deposits by the test cells was developed as far back as the ancestors of the genera *Distoma* and *Cystodytes* (see fig. 13), and if so, then the tendency has been repressed in the species of *Distoma*.

In the ancestral Didemnidæ the male reproductive organs became concentrated to form a single large ovate testis around which the long vas deferens was coiled spirally (see p. 254). The genus *Didemnum* is rather less modified than *Leptoclinum*, which forms the termination of this branch. In *Leptoclinum* the colony has become greatly flattened from above downwards so as to form in most cases a mere incrusting film in which the test is usually densely crowded with calcareous spicules. One result of this flattening of the colony in the more modified Leptoclinids is that remarkable bending of the body

of the Ascidiozooid which has been already described in the case of *Leptoclinum moseleyi* (see p. 273), where it has resulted in the abdomen having come to lie at right angles to the thorax in place of being in the same straight line with it. In other cases the Ascidiozooids have remained unflexed, but have become scattered irregularly in the test inclined at various angles to the surface of the colony.

In the ancestral Diplosomidæ the reproductive organs have remained in a more primitive condition than in the Didemnidæ, and the vas deferens has become straightened. The testes are usually two in number, and are therefore in an intermediate state between the numerous spermatic vesicles of the ancestral Distomidæ and the single large testis of the Didemnidæ. The property of producing calcareous spicules in the test has become gradually lost in the Diplosomidæ. Spicules are still found in the upper layer of the colony in *Diplosomoides* (see p. 309), but have completely disappeared in the genus *Diplosoma*. As a result the test has become softer and more transparent, and the system of canals and cavities in connection with the common cloacal apertures has become at the same time so increased as to greatly reduce the relative amount of test present in the colony (see p. 308). *Diplosomoides* is less modified than *Diplosoma* (see fig. 13, p. 393), and is more nearly related to the Didemnidæ.

In order to trace the evolution of the remaining Compound Ascidians, it is necessary to return to the ancestral Ascidian allied to *Ecteinascidia* (B. in fig. 11, p. 388). This form was the common ancestor of the various groups of Simple Ascidians, and it is described in the first part of this Report (vol. vi., 1882, p. 285). It gave rise to an ancestral series which, after losing the power of reproducing by gemmation and undergoing a certain amount of modification, led to *Ciona* and the other genera of the Ascidiidæ.[1] From the ancestral Ascidiidæ an important branch leads to a great series of forms in which the body has become shortened antero-posteriorly by the alimentary canal being placed alongside the branchial sac instead of extending behind it, while the branchial sac has become more highly developed and has had its surface greatly increased by being thrown into a series of longitudinal folds. Before this last change took place, however, the branch probably divided (at J. in fig. 11, p. 388) into two ancestral series, one leading to the family Botryllidæ and the other to the primitive Cynthiidæ (see fig. 11, J.).

In the long line of descent leading from the point J. to the family Botryllidæ the lost property of reproducing by gemmation was regained, and as a result colonies were once more produced. The Ascidiozooids in these primitive Botryllidæ were completely imbedded in a common test, and they became arranged in systems as in the case of the Polyclinidæ, and finally in each system all the atrial apertures came to open into a

[1] For the phylogeny of the Simple Ascidians see Part I. of this Report in vol. vi., 1882, Summary, p. 285. The subject will be discussed more in detail in Part III. of this Report, where the relationships between the various groups of the Tunicata will be fully considered.

centrally placed common cloacal cavity. The test became penetrated by a well-developed system of blood-vessels with enlarged terminal bulbs in the superficial layer of the colony, forming in all probability an accessory organ of respiration. This system is evidently the same as that found in the test of some of the Ascidiidæ, and it has been inherited by the Botryllidæ from their ancestors amongst the Ascidiæ Simplices. The Simple Ascidians in their turn inherited the blood-vessels of the test from their ancestors the primitive Clavelinidæ (see fig. 11, p. 388), in which these structures were limited to the posterior end of the body and the stolons. This system in the Clavelinidæ was originally a bud-producing apparatus, and when the property of gemmation was lost (in the Ascidiidæ) it became useful as an accessory organ of respiration,[1] and was seized upon and evolved by the action of natural selection into the complicated system of vessels and bulbs found in some Ascidiidæ and Botryllidæ. It is interesting to find that in the Botryllidæ, where the property of gemmation has been acquired, the vessels in the test have in some cases (*e.g.*, *Sarcobotrylloides wyvillii*, see p. 59) returned to their original function of producing buds in their terminal enlargements.

The branchial sac in the Botryllidæ is well developed, and agrees with that of the Simple Ascidians from the point B. (fig. 11, p. 388) onwards in having well developed internal longitudinal bars. The reproductive organs are found in a condition which suggests the close relationship with the ancestral Cynthiidæ, which is shown in the diagram (fig. 11, p. 388).

The genus *Symplegma*, as I have already pointed out (p. 144), unites the characters of the families Distomidæ and Botryllidæ. In the systematic part of this Report I placed *Symplegma* with some hesitation in the Distomidæ, but I am rather inclined now to regard it, on account of the structure of its branchial sac and dorsal lamina, as being more closely related to the Botryllidæ than to the Distomidæ, and therefore I have placed it provisionally in the phylogenetic table (fig. 11, p. 388) on the termination of a side branch from the ancestral Botryllidæ.

For the different conditions of colony, systems, and Ascidiozooids found in the four genera of the Botryllidæ I may refer to the systematic part of this Report (see p. 37), where they are described and their probable relations discussed. The ancestral Botryllidæ, with moderately thick colonies, probably divided into two series; one—with regular stellate systems and ovate Ascidiozooids—leading to (1) *Botryllus*, in which the colony became thin and incrusting, and (2) *Polycyclus*, in which the colony became thick and massive; and the other—with elongated irregular systems and cylindrical Ascidiozooids—giving rise (1) to *Botrylloides* with thin colonies, and (2) to *Sarcobotrylloides* with thickened colonies (see fig. 15, p. 398). The manner in which the systems probably became complicated, and in which the Ascidiozooids may have changed their form as a result of the modification of the systems, has already been described (see p. 40).

[1] See Herdman, On the Evolution of the Blood-Vessels in the Test of the Tunicata, *Nature*, vol. xxxi. p. 247.

The primitive Cynthiidæ derived from the ancestral form J. (fig. 11, p. 388) acquired longitudinal folds in the branchial sac and then divided into two series, the one leading to the Styelinæ and the Polystyelidæ, and the other giving rise to the remaining Cynthiidæ and the Molgulidæ. In the primitive Styelinæ the tentacles remained simple, as they were in the ancestral Simple Ascidians, and the number of folds in the branchial sac became limited to four on each side. The reproductive organs assumed the form of two or more hermaphrodite masses (called polycarps) attached to the inner surface of the mantle upon each side of the body. At the point K. (fig. 11, p. 388) these ancestral forms divided into two series, those leading to the true Styelinæ on the one hand, and to the primitive Polystyelidæ on the other.

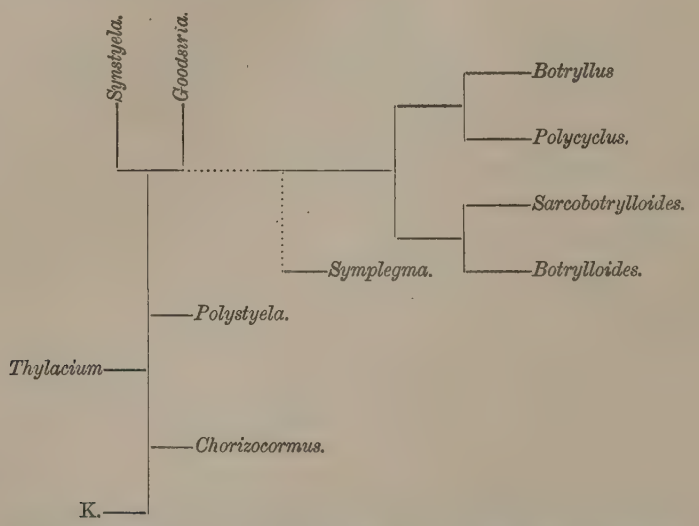


FIG. 15.—Diagram illustrating the phylogeny of the Polystyelidæ and the Botryllidæ, and their possible connection. K. indicates the point where the Polystyelidæ diverged from the Styelinæ.

The genus *Chorizocormus* is an important transition form between the Styelinæ and the Polystyelidæ proper (see p. 345). It is probably the nearest form known to the ancestral Polystyelidæ, and may therefore be placed (see fig. 15) on a short side branch springing from the axis of the Polystyelidæ not far above the point K.

Thylacium and *Polystyela* are derived from side branches between the ancestral *Chorizocormus* and the ancestral *Synstyela* or *Goodsiria*. They have the Ascidiozooids projecting somewhat above the general surface of the colony, and therefore bear much the same relation to the higher Polystyelidæ that the genus *Diazona* does to the typical Distomidæ. The axis of the Polystyelidæ finally divides into two branches, allowing the two most highly evolved forms in the family, *Synstyela* and *Goodsiria*, to diverge in opposite directions (see fig. 15). In *Synstyela* the colony has become thin and incrusting,

while in *Goodsiria* the test is greatly enlarged, thus rendering the colony thick and massive. In none of the Polystyelidæ have the Ascidiozooids come to be arranged in systems, and no common cloacal cavities have been formed; the atrial apertures of all the Ascidiozooids open independently upon the exterior of the colony. In this respect the colony is in the same stage of differentiation as that reached by most of the Distomidæ, while the other groups of Compound Ascidians (*e.g.*, Botryllidæ, Polyclinidæ, Didemnidæ) have advanced a stage further by the formation of systems with common cloacal cavities.

It is possible that the family Botryllidæ may have a closer relationship with the Polystyelidæ than I have assigned to it above (p. 396). The primitive Botryllidæ, in place of arising from the primitive Cynthiidæ, may possibly have been derived from the Polystyelidæ near the point where *Synstyela* and *Goodsiria* diverged, as is shown by the dotted line in the diagram (fig. 15). In that case the evolution of the primitive Botryllidæ would consist in the gradual formation of systems in the colony, and the complete disappearance of all traces of folds in the branchial sac.

Probably the two most important conclusions I have arrived at in these phylogenetic investigations are—(1) as to the relationship of *Pyrosoma*, and (2) as to the polyphyletic origin of the Ascidiæ Compositæ. *Pyrosoma*, although now a pelagic free-swimming organism, was probably derived from the fixed Compound Ascidians. The discovery of *Cœlocormus huxleyi* shows the relationship between *Pyrosoma* and the primitive Didemnidæ, and the latter in their turn were derived from the primitive Distomidæ; consequently, *Pyrosoma* is directly related to the most typical of the Compound Ascidians.

The Ascidiæ Compositæ, or Synascidæ, are really an unnatural assemblage of groups, as they seem to have been derived from the Simple Ascidians or their ancestors at two or three distinct points (see fig. 11, p. 388). The result of this is that the so-called Compound Ascidians form three[1] groups—(1) the Polystyelidæ, (2) the Botryllidæ, and (3) the remaining families—which are more nearly related to particular groups of Simple Ascidians than they are to one another. This conclusion renders it even more difficult than it was before to draw any line of demarcation between Simple and Compound Ascidians.

[1] Possibly (1) and (2) may have had a common origin, as is shown in fig. 15, p. 398.

APPENDIX A.

SUPPLEMENTARY REPORT UPON THE ASCIDIÆ SIMPLICES.

Since the publication of the First Part of this Report in 1882, several specimens of Simple Ascidians belonging to the Challenger collection have been sent to me for examination. Some of these were found in the bottles at the Challenger office, while others had been returned by the naturalists who were working at other groups in which specimens of Ascidians had been accidentally included. One of these was a new species of the interesting genus *Culeolus*, and this reached me just in time to be noticed in Part I. (see p. 276). Another (*Bathyoncus discoideus*) is a very remarkable specimen attached to a manganese nodule from deep water. This form and another smaller species (*Bathyoncus minutus*) may probably be referred to the genus *Bathyoncus* formed in the first part of the Report for the species *Bathyoncus mirabilis*, also an abyssal form.

The remaining species described below have no very remarkable peculiarities, and they fall naturally into well-known genera. With the exception of a new species of *Ciona* from Japan, they all belong to the family Cynthiidæ.

Two species belonging to the "Porcupine" collection, which have reached me since the publication of the Report upon the Simple Ascidians of the "Lightning" and "Porcupine" Expeditions,[1] are also included in this Appendix. One of them is a new species of *Molgula*, which has straight stigmata in the branchial sac, and therefore indicates a transition towards the Cynthiidæ.

Family Molgulidæ.

The following is an interesting newspecies of *Molgula*, which was obtained from a depth of 440 fathoms in the North Atlantic.

Molgula carpenteri, n. sp. (Pl. XLVII. figs. 1, 2).

External Appearance.—The shape is ellipsoidal or nearly spherical, and the body is not attached. The edges are rounded, and there is slight lateral compression. Both

[1] *Trans. Roy. Soc. Edin.*, vol. xxxii. part ii. p. 219, 1884.

apertures are placed on the wide anterior end; they are moderately far apart, and are sessile and inconspicuous. The branchial aperture is six-lobed and the atrial four-lobed. The surface is entirely covered with a thick coating of sand. The colour is yellowish-brown.

The length of the body is 3 cm., the greatest breadth is 2·3 cm., and the thickness is 1·8 cm.

The Test is thin but moderately tough.

The Mantle is thin and membranous. The musculature is not strong, but it is in the typical Molgulid condition; the bodies of the muscles are wide, and the tendons are long and slender.

The Branchial Sac is large. There are five distinct folds upon each side. The internal longitudinal bars are straight and strong. There are about eight bars upon each side of a fold, and six in the interspace between two folds. The transverse vessels are placed far apart, and they are of two sizes, which occur alternately. Three delicate horizontal membranes are found between each pair of transverse vessels. The stigmata are straight, and they are very long. The ciliated cells are distinct.

The Dorsal Lamina is a membrane marked with slight transverse ribs. Its free margin is irregular, but is not distinctly toothed.

The Tentacles are large and much branched. There are eight large and a number of smaller intermediate ones.

Locality.—Station 51 (of "Porcupine" expedition in 1869); lat. 60° 6′ N., long. 8° 14′ W.; depth, 440 fathoms; date, August 17, 1869.

Several specimens[1] of this interesting new species of *Molgula* were obtained during the cruise of the "Porcupine" in the summer of 1869, off the north-west coast of Scotland, from a depth of 440 fathoms. It is a moderately large species, and all the specimens are of much the same size. The external appearance (Pl. XLVII. fig. 1) is not unlike that of *Molgula occulta*, Heller, but the internal structure is very different.

When the thin but sandy test is removed the mantle is seen to be very transparent. The course of the alimentary canal and the position of the long narrow reproductive organ upon each side of the body are clearly visible. The musculature is delicate, but most beautifully marked. The fusiform muscle bands are conspicuous in the transparent membranous mantle. The endostyle is narrow and straight.

The folds in the branchial sac are well-marked. They are of the very unusual number of five on each side. *Molgula chrystallina*, Møller, has the same number of folds, but is a very different species,[2] in which the test is not incrusted and the stigmata in the branchial sac are in the usual spiral condition. The most remarkable

[1] I am indebted to Dr. P. Herbert Carpenter, F.R.S., for having kindly sent me these specimens for examination.

[2] See Traustedt, Oversigt over de fra Danmark, &c., Ascidiæ Simplices, and Ascidiæ Simplices fra det Stille Ocean, *Vid. Meddel. nat. Foren. Kjøbenhavn*, 1880 and 1885.

feature in the present species is the shape of the stigmata. They are perfectly straight (Pl. XLVII. fig. 2, *sg.*), and in this respect differ from those of the other Molgulidæ. The only approach to this extraordinary condition is what is seen in the branchial sacs of *Ascopera pedunculata* and of *Molgula pedunculata*, where the stigmata are sometimes straight and sometimes curved.[1] They are never, however, arranged in regular transverse rows as they are in the case of the present species (Pl. XLVII. fig. 2, *sg.*). This structure of the branchial sac seen in *Molgula carpenteri* is exactly like that of most species of the Cynthiidæ, and in this respect the present species and *Ascopera pedunculata* form a perfect transition from the typical Cynthiid to the typical Molgulid condition. *Molgula carpenteri* is, however, notwithstanding its straight and regularly arranged stigmata, an undoubted *Molgula*. The other organs of the body have all the characteristics of the Molgulidæ, and the fact that an approach to the straight condition of the stigmata is found in *Molgula pedunculata* prevents the new species being raised to generic rank.

Family Cynthiidæ.

Most of the species described in this Appendix belong to this, the largest family of the Simple Ascidians, and the three subfamilies, the Bolteninæ, the Cynthinæ, and the Styelinæ, which were formed in the First Part of this Report, are all represented.

Subfamily 1. Bolteninæ.

This group of the Cynthiidæ is represented by a new species of the remarkable deep-sea genus *Culeolus*. I have named it in memory of Dr. R. von Willemoes-Suhm, who was the first naturalist to examine a species of the genus (*Culeolus perlatus*,[2] Suhm).

Culeolus willemoesi, n. sp. (Pl. XLVIII. figs. 1–4).

External Appearance.—The body is fusiform in shape, and the peduncle is very long and slender. The widest part is about the middle of the body, and both the ends taper to narrow points. The anterior end passes gradually into the peduncle. The dorsal edge is rather more convex than the ventral. The two sides are about equally rounded. The peduncle is slight, but moderately tough. It springs from the anterior end of the body immediately on the ventral side of the branchial aperture, and it runs at first anteriorly and then turns dorsally and posteriorly, and then goes straight to its base of attachment. The apertures are both conspicuous. The branchial is placed close to the

[1] See Part I. of this Report, pp. 65 and 74.

[2] See Part I. of this Report, p. 115.

peduncle on its dorsal edge. It is triangular in shape and is surrounded by a somewhat circular raised margin. The atrial aperture is large, and has the form of a transverse slit. It is placed on the dorsal edge of the body more than half way back.

The surface is smooth in most places, but there are two projections on the ventral side of the peduncle at the anterior end of the body. A broad band of small pointed tubercles runs longitudinally along the ventral edge, and two narrow lines run transversely one behind the branchial aperture and another in front of the atrial. The latter terminates ventrally at the most posterior point of the body in a slight toothed ridge. The colour is a dull opaque grey.

The length of the body (antero-posterior) is nearly 1 cm. The breadth of the body (dorso-ventral) is 6 mm. The length of the peduncle is about 7 cm. The thickness of the peduncle is 0·5 mm.

The Test is thin but tough and opaque.

The Mantle is moderately strong.

The Branchial Sac has several slight folds upon each side; each fold is formed of three or four internal longitudinal bars. The transverse vessels are narrow; they are all of the same size, and are placed rather far apart. The internal longitudinal bars are much stronger and more closely placed. The meshes are vertically elongated. Calcareous spicules are present in the internal longitudinal bars, and occasionally extend into the transverse vessels; they are not numerous, but are large and slightly branched.

The Tentacles are pinnate. They are provided with spicules.

Locality.—Station 241, June 23, 1875; lat. 35° 41′ N., long. 157° 42′ E.; depth, 2300 fathoms; bottom temperature, 35°·1 F.; bottom, red clay.

One specimen of this new species of *Culeolus* was dredged at Station 241, in the Pacific Ocean, to the west of Japan, from the great depth of 2300 fathoms. The large species *Culeolus murrayi* was obtained at the same locality.

Culeolus willemoesi is the smallest species of *Culeolus* known. It differs from *Culeolus recumbens* and *Culeolus perlucidus* in having the peduncle running anteriorly from the body; it differs from *Culeolus perlatus* and from *Culeolus murrayi* in having no marked band of tubercles around the atrial aperture; and lastly, it differs from both *Culeolus wyville-thomsoni* and *Culeolus moseleyi* in the surface of the test, which is neither perfectly smooth, as in *Culeolus wyville-thomsoni*, nor yet evenly roughened all over as in *Culeolus moseleyi*. It also differs from *Culeolus murrayi*, *Culeolus wyville-thomsoni*, and *Culeolus moseleyi* in the position of the atrial aperture, and from *Culeolus recumbens* and *Culeolus perlucidus* in the shape of the body. In some respects it is more like *Culeolus perlatus* than any of the previously described species, but differs from it in the peduncle, the branchial aperture, the surface of the test, and other points.

The posterior end is long and pointed, giving the body as a whole a fusiform shape (see Pl. XLVIII. fig. 1). The apertures are distinctly marked. The branchial is triangular (Pl. XLVIII. fig. 3) and lies in an elliptical depression, surrounded by a raised margin cleft into a number of segments (Pl. XLVIII. fig. 3). It is rather a small aperture, and the apex of the triangle points posteriorly, the base being next to the peduncle. The atrial aperture seems larger, but unfortunately it is torn in the only specimen of the species. It was apparently transversely ovate in shape, and was surrounded by a raised margin.

The tubercles on the anterior end of the ventral edge of the body, opposite to the branchial aperture (Pl. XLVIII. fig. 1), are the only marked processes of the test. The other smaller projections are placed chiefly along the ventral edge of the body and at the posterior end.

The branchial sac (Pl. XLVIII. fig. 2) is of the usual Culeolid structure. It is not unlike that of *Culeolus perlatus*, but the meshes are more elongated vertically in the present species. The branchial folds are fairly well-marked (Pl. XLVIII. fig. 2, *brf.*), and the usual spicules are present in the internal longitudinal bars.

The tentacles are fairly large, but they are sparingly branched (Pl. XLVIII. fig. 4).

Subfamily 2. Cynthinæ.

In this group of the Cynthiidæ additional specimens of two previously known species of *Cynthia* have to be recorded. In the case of one of these species (*Cynthia pallida*, Heller) the new specimens extend the known geographical range of the species, and also its bathymetrical range, but in the other case (*Cynthia papietensis*, Herdman) the additional specimens are from the same locality as those previously examined.

Cynthia pallida, Heller.

Two additional specimens of this species have been sent to me for description. In the one from Station 192 the body is much flattened, the apertures are not far apart, they are sessile, but not inconspicuous. The colour is pale white, and hyaline on the edge. A little sand adheres, chiefly on the left side and the posterior end of the right side. The long convoluted yellow ovary shows through on the right side of the body. The length is 3 cm., and the breadth (dorso-ventrally) is 3·5 cm.

The test is thin and semi-transparent. It contains many spicules; some of these are large, while smaller ones are found in the vessels as in the case of *Cynthia papietensis*.[1] The mantle is rather thin, and adheres to the inner surface of the test. It is full of large fusiform spicules.

[1] See this Report, part i. p. 144, pl. xvii. fig. 14.

The branchial sac is large and very delicate. It has eight large folds upon each side, the folds being about equal in width to the interspaces. Several Crustacea were found in the branchial sac.

The endostyle is very distinct, but narrow; it is white in colour. The tentacles are compound and large. There seem to be only twelve longer tentacles, which are greatly branched, and some smaller intermediate ones.

The dorsal tubercle is placed in a deep triangular peritubercular area; it is small and ovate in form, with the longer axis vertical. The aperture is lateral.

The intestine is very long and narrow. The ovaries are in the form of a long convoluted yellow tube upon each side of the body.

One specimen of this species was obtained at Station 192, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; depth, 140 fathoms; and a second was sent in a bottle containing no label: the locality of this specimen is consequently not known. The specimens described in the First Part of the Report were obtained from Simon's Bay, Cape of Good Hope, and Kandavu, Fiji Islands, all in shallow water, consequently the specimen from Station 192 has extended the known bathymetrical range of the species by upwards of 100 fathoms.

Since the publication of the First Part of this Report, and after the preceding description of the new specimens of *Cynthia pallida* had been drawn up, I received from Dr. C. Ph. Sluiter of Batavia, a letter giving an account, with sketches, of a variety of the species which he has since described[1] and figured under the name of *Cynthia pallida*, var. *billitonensis*. The species is evidently a variable one. Dr. Sluiter's specimens, obtained in shallow water off the Island of Billiton, in the Malay Archipelago, are of larger size than any of the Challenger specimens, and they also differ somewhat in the shape of the spicules, and in other details. The dorsal tubercle is figured by Sluiter as having symmetrically coiled horns and an anterior median aperture. In the Challenger specimen from Station 192, as I have stated above, the aperture is lateral, and therefore the tubercle is unsymmetrical. This organ is liable to great variation in some species.

Cynthia papietensis, Herdman.

Cynthia papietensis, Herdman, Report upon Challenger Tunicata, part i. p. 143, pl. xvii. figs. 10–16.

A small bottle containing three specimens of this interesting little species has reached me since the publication of the First Part of this Report. It is labelled Papiete Harbour, Tahiti, 20 fathoms, the only locality known for the species. These additional specimens do not differ in any noteworthy points from those previously examined.

[1] Ueber einige einfachen Ascidien, &c., *Natuurkund. Tijdschr. v. Nederlandsch. Indie*, Band xlv. p. 160, Batavia, 1885.

Subfamily 3. Styelinæ.

Several representatives of this group of the Cynthiidæ have to be added to those previously described. The most noteworthy are the two remarkable species *Bathyoncus discoideus* and *Bathyoncus minutus*, for the reception of which I was inclined at first to found a new genus. It is better probably to refer them provisionally to the genus *Bathyoncus*, from which, however, they may possibly have to be separated afterwards when they become better known. There is only a single specimen of each species in the collection, and that of *Bathyoncus minutus* is much damaged. This latter form was obtained from a depth of 3125 fathoms, the greatest depth at which Tunicata have yet been found. The larger species, *Bathyoncus discoideus*, is a remarkably flattened disk-like form, which was found adhering to a manganese nodule brought up from a depth of 2300 fathoms.

Bathyoncus discoideus, n. sp. (Pl. XLVII. fig. 6; Pl. XLVIII. figs. 5–11).

External Appearance.—The shape is discoidal and almost perfectly flat. It is attached by the whole of one surface, and has a slight spreading margin. The apertures are both quadrate; they are situated on the upper flattened surface, and are moderately far apart. The surface is nearly smooth. The colour is pale grey, with a slaty tinge in some places.

The diameter in a line joining the two apertures is 2·9 cm., and the diameter at right angles to that is 3·1 cm.

The Test is thin but tough. It is almost opaque on the upper surface, but quite transparent on the lower attached surface. The upper surface is slightly corrugated.

The Mantle is thin and membranous. The musculature is close but very delicate.

The Branchial Sac has several folds upon each side. The internal longitudinal bars are well developed. There may be as many as eight bars on one of the larger folds. The transverse vessels are rather narrower than the internal longitudinal bars, and are all of the same size. The meshes are large, and are slightly elongated vertically.

The Tentacles are simple, and few in number.

The Alimentary Canal is relatively of small size. It is placed on the left side of the body, and forms an open loop.

The Reproductive Organs are in the form of small rounded bodies scattered over both sides of the mantle.

Locality.—Station 241, June 23, 1875; lat. 35° 41′ N., long. 157° 42′ E.; depth, 2300 fathoms; bottom, red clay; bottom temperature, 35°·1 F.

This is one of the most remarkable of the new Simple Ascidians discovered during the Challenger Expedition. A single specimen was obtained in the North Pacific, to the

east of Japan, from a depth of 2300 fathoms. It agrees with the genus *Bathyoncus*, as characterised in the First Part of this Report, in having four-lobed apertures, simple tentacles, and a branchial sac with folds but no true stigmata. It differs, however, very greatly from *Bathyoncus mirabilis*, the type species of the genus, in the condition of the reproductive organs and in the shape of the body (see Pl. XLVIII. fig. 5); possibly it may have to be separated from *Bathyoncus* when the Deep-sea Ascidians come to be more thoroughly known.

The body in *Bathyoncus discoideus* is flattened antero-posteriorly to such an extent that the test forms merely a basal expansion attached to the surface of the manganese nodule, and an upper expansion which is very slightly curved and forms the anterior end of the body on which the branchial and atrial apertures are placed. The margin forms a slight spreading edge (Pl. XLVIII. fig. 5). The surface of the test is marked by fine concentric ridges or striæ. The apertures are distinct (Pl. XLVIII. fig. 5) but not prominent.

The test on the posterior part of the body is extremely thin, and all the inequalities of the surface of the manganese nodule are seen through it distinctly. The upper part forming the anterior surface of the body is tougher and more opaque.

The mantle has the muscle bands running in all directions (Pl. XLVIII. fig. 6), so as to form an intricate network.

The branchial sac shows the remarkable open structure first discovered in the genus *Culeolus*, and which seems to be associated with the abyssal zone. It has been found in both Simple and Compound Ascidians, but only in forms from deep water. The branchial folds are of various sizes. A small fold consists of two closely placed bars only (see Pl. XLVIII. fig. 8), while a large fold has as many as eight bars (Pl. XLVIII. fig. 9). The meshes between the folds are large (Pl. XLVIII. fig. 8). The inner edges of the internal longitudinal bars are thickened, but no cilia are present (Pl. XLVIII. figs. 8, 9, 10). A few calcareous spicules are present in the internal longitudinal bars, but they are very small and difficult to see. They are visible under a high power (see Pl. XLVIII. fig. 10). The tentacles are short and stout (Pl. XLVIII. fig. 7). The anterior edge of the tentacle is thickened.

The alimentary canal is short and of small calibre (Pl. XLVII. fig. 6). It lies on the dorsal edge of the left side of the body, behind the branchial sac. The œsophagus is short and funnel-shaped (Pl. XLVII. fig. 6). The stomach is small and globular; it is smooth-walled. The intestine curves round in a wide loop so as to reach the œsophagus, close to which it terminates, not far from the atrial aperture. The intestine, like every other part of the body, is flattened, and is about 1·5 mm. in width. It is of a light grey colour, and is thin-walled and almost transparent.

The reproductive organs are situated on both sides of the body. They are in the form of small scattered clumps, possibly modified polycarps, most of which occur upon

the left side, outside the loop of the intestine (see Pl. XLVII. fig. 6). A few also occur on the right side of the body. Each clump consists of a number of small rounded masses, united to the base of a short tubular duct (see Pl. XLVIII. fig. 11) which opens into the peribranchial cavity.

Bathyoncus minutus, n. sp. (Pl. XLVII. figs. 7–10).

External Appearance.—The shape is nearly discoid, and the body is flattened antero-posteriorly. It is attached by the entire lower surface. The margin is expanded and very thin. The apertures are placed on the upper surface, and are rather far apart. They are both of small size but distinctly visible, and are placed upon slight papillæ. They are not regularly lobed, but each aperture has a number of slight grooves radiating from it. The surface is even, but minutely roughened. The colour is dark brown.

The diameter of the body is 5 mm., and the thickness is about 0·5 mm.

The Test is stiff and somewhat brittle, but thin. It is leathery in consistence. It is of a yellowish-brown colour on the inner surface, but is darker in the neighbourhood of the apertures. The upper surface is raised into a number of small blunt projections, which are especially numerous around the apertures.

The Mantle is closely united to the inner surface of the test. It is moderately muscular. There are a number of longitudinal bands which radiate from the two apertures; these, with the circular muscle bands, form a network over the anterior part of the body (see Pl. XLVII. figs. 9, 10). The sphincters around the apertures are rather strong.

The Branchial Sac appears to have no folds. The transverse vessels and internal longitudinal bars are few in number, but wide; they form large meshes.

The Dorsal Lamina is a plain membrane.

The Tentacles are few and simple. They are of two sizes, which occur alternately.

The Alimentary Canal is short and has no complications. It forms a simple loop.

The Reproductive Organs form a single mass attached to the mantle.

Locality.—Station 253, July 14, 1875; lat. 38° 9′ N., long. 156°·25′ W.; depth, 3125 fathoms; bottom, red clay; bottom temperature, 35°·1 F.

One specimen of this small species was obtained attached to a nodule of manganese dredged in the North Pacific Ocean from the great depth of 3125 fathoms. The specimen had been detached and mounted in glycerine as a microscope slide before it came into my hands. It is almost perfectly flat now (Pl. XLVII. fig. 7), but I am inclined to think that it has been squeezed while mounting, and is really unnaturally flattened and somewhat distorted. The lower surface by which it was attached is black, and has small particles of the manganese still attached to it; the upper has the thin and irregularly expanded margins black, while the central part which, when living, was probably slightly convex, is of a brown colour. The two apertures are placed at the edges of the brown part of the

body, and are consequently about as far apart as they can possibly be (Pl. XLVII. fig. 7). They look as if they were extremely contracted, and although no traces of lobes are visible they may have been square when opened. Figures 9 and 10 on Plate XLVII. show the branchial and atrial apertures seen from the inside. When magnified about 50 diameters the brown upper surface of the test is seen to be distinctly roughened, and to consist of a yellowish ground mottled with brown and black marks. The lower surface, on the other hand, is of a dull black colour throughout. The test is particularly stiff, and seems almost horny in texture. The musculature in the mantle is well developed (Pl. XLVII. figs. 9, 10).

The branchial sac has the usual open structure with no true stigmata. The meshes are particularly large, and the vessels are wide and membranous. No cilia are visible. The endostyle is distinct; it is of a yellowish colour.

The tentacles are probably eight in number, four of them long and the other four shorter (see Pl. XLVII. fig. 9).

The œsophagus is a plain tube (Pl. XLVII. fig. 8). The stomach is globular and rather large. The intestine is short and wide; it forms a narrow loop. The stomach and intestine are of a yellowish-brown colour.

The only reproductive organs present in the single specimen are in the form of a mass of mature ova of an orange colour attached to the inner surface of the mantle.

Possibly this species, on account of the absence of folds in the branchial sac, ought to be placed in a separate genus from *Bathyoncus*, but the single specimen seems somewhat distorted, and slight folds may possibly be present, consequently I have thought it best to leave the species in the genus *Bathyoncus* for the present.

Styela radicosa (*?*), Herdman (Pl. XLIX. figs. 9, 10).

Styela radicosa, Herdman, Report upon Challenger Tunicata, part i. p. 163, pl. xxiv. figs. 6, 7.

This specimen, from Station 163, is very like the specimen described as *Styela radicosa* in the First Part of this Report (p. 163, Pl. XXIV. figs. 6, 7) in many of its characters, but does not agree perfectly in all details.

The form of the body is much the same (Pl. XLIX. fig. 9), but the posterior end is not so globular, and the root-like processes of the test are not so well marked. Also, the anterior end does not taper so much, and, as a result, the atrial aperture is placed nearer to the branchial, which is terminal in *Styela radicosa* and decidedly on the ventral edge in the present specimen. Then, again, the transverse wrinkling of the test is very slight, and not so much distributed as in *Styela radicosa*, and the colour is different. It is much darker, being creamy grey in some places and brown in others. It does not become paler towards the posterior end as in the case of *Styela radicosa*.

The length of the body is 2·2 cm., the greatest breadth is 1·5 cm., and the thickness is 0·9 cm.; hence there is considerable lateral compression.

The test is strong and tough and quite opaque. It is, however, rather thin except at the posterior end. It is white on section.

The mantle is very thick, and has imbedded in it large pale genital glands, which from their number and appearance might almost be considered as polycarps.

The branchial sac is strong. There are four folds upon each side, and they seem to vary somewhat in size, two or three being large, as in *Styela radicosa*, and the rest much slighter. The branchial sac in other characters (Pl. XLIX. fig. 10) resembles that of *Styela radicosa* (*cf.* Pl. XXIV. fig. 7, in the First Part of the Report). The internal longitudinal bars are broad and ribbon-like. The transverse vessels are all of about the same size, with the exception of the occasional much wider ones (Pl. XLIX. fig. 10, *tr.*). In some places the sac is very irregular. The figure given shows four rows of stigmata passing first into three then into two and finally into one at the edge of the fold (*br.f.*).

The tentacles are large. The branchial aperture is so much invaginated (probably through sudden and extreme contraction) as to fill up the branchial siphon and cover completely the prebranchial zone and the bases of the tentacles. The dorsal tubercle is in the same condition as in *Styela radicosa*.

In a case like the present one, where a species was described from a single specimen and then another specimen turns up afterwards which differs somewhat from the first, it is very difficult to decide whether the two should be united or considered distinct species. I think it best, taking into consideration what we know as to individual variation in Ascidians, to refer the present species to *Styela radicosa*, at least until some other specimens are found which will throw light upon the affinities of the two forms. This specimen was obtained at Station 163D, June 12, 1874, Twofold Bay, Australia; lat. 33° 57′ 30″ S., long. 151° 39′ 15″ E.; depth, 120 fathoms; bottom, green sand.

Styela pusilla, n. sp. (Pl. XLIX. figs. 7, 8).

External Appearance.—The body is dome-shaped or almost hemispherical. The posterior end forms the wide base of attachment, and has a slightly expanded margin. The anterior end is convex, and the sides are alike. The apertures are both anterior, not distant, and very inconspicuous. The surface is minutely wrinkled all over so as to give it a roughened appearance. The colour is an earthy brown.

The length of the body is 4 mm., the greatest breadth of the body is 6 mm.

The Test is moderately thick and rather tough. It is quite opaque. The inner surface is smooth, and of a bluish-white colour.

The Mantle is yellow in colour, and has the musculature well developed. It is attached to the test closely at the apertures only. The bundles of muscle fibres form a close but fine network. The sphincters are strong.

The Branchial Sac has several folds upon each side. The transverse vessels are moderately wide and all alike. The internal longitudinal bars are not very stout. The

meshes are elongated vertically, and contain each three to five stigmata, which are rather wider than the vessels between them. Muscle fibres are present in the transverse vessels.

The Tentacles are few in number but rather long.

Locality.—Station 246, July 2, 1875; lat. 36° 10′ N. long., 178° 0′ E.; depth, 2050 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·1 F.

This species, although very small, is evidently adult, since the genital gland was found to contain masses of large and mature ova. There is nothing noticeable about the external appearance (Pl. XLIX. fig. 7) of the single specimen. It might almost pass for a rather wrinkled and shabby looking individual of *Styela grossularia* of our own coasts, and yet it was obtained from a depth of over 2000 fathoms in the centre of the North Pacific Ocean.

The branchial sac (Pl. XLIX. fig. 8) is very brittle, but exhibits none of the peculiarities found in the case of some other deep-sea Ascidians. The stigmata are regular, and of the ordinary size. Cilia are present and have the usual arrangement, and no spicules are found in the vessels.

Polycarpa longisiphonica (*?*), Herdman (Pl. XLIX. figs. 4–6).

Polycarpa longisiphonica, Herdman, Report upon Challenger Tunicata, part i. p. 177, pl. xxiii. figs. 3–6.

This single specimen of *Polycarpa*, from Station 162, resembles *Polycarpa longisiphonica* in most particulars, but is rather different in external appearance. It is especially deficient in the characteristic from which that species derives its name, as the present specimen has the apertures sessile, though large and distinct (see Pl. XLIX. fig. 4), while in *Polycarpa longisiphonica*[1] they are placed upon the summits of singularly long projections. Then, again, the anterior extremity in this specimen is wide, while in *Polycarpa longisiphonica* it is narrow as compared with the rest of the body. The specimens of *Polycarpa longisiphonica* formerly described were either free or only very slightly attached, while the present specimen is attached to the interior of a Lamellibranch shell by a large part of its left side (Pl. XLIX. fig. 4). In the present specimen the lobes of the apertures are very much larger than those in the specimens from Port Jackson.

Notwithstanding all this external difference, the branchial sac of the present specimen (Pl. XLIX. fig. 5) is extremely like that of *Polycarpa longisiphonica*.[2] Figure 5 on Plate XLIX. shows a fold and a complete interspace formed of six rows of meshes, each more or less square in shape, and containing four to six stigmata very regularly arranged. The fold shown (*br.f.*) has nine internal longitudinal bars, the next one had eight. The transverse vessels are of three sizes (see

[1] See this Report, part i. pl. xxiii. fig. 3.

[2] See this Report, part i. pl. xxiii. fig. 4.

tr and *tr''*), usually placed alternately, as seen in the figure. No narrow horizontal membranes were noticed.

It is impossible to say with certainty whether this specimen should be described as a new species or referred to *Polycarpa longisiphonica*. I prefer to take the latter course until more specimens have been examined, and it has been determined whether or not that species has a wide range of variation.

The specimen measures 3·8 cm. in length and 2·2 cm. in greatest breadth. It was obtained at Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; depth, 38 fathoms; bottom, sand and shells.

Polycarpa bassi, n. sp. (Pl. XLIX. figs. 1–3).

External Appearance.—The body is oblong in outline, and somewhat compressed laterally. The posterior end is rounded, and the area of attachment is on its left side. The anterior end is broad and truncated, it runs obliquely forwards and ventrally. The dorsal and ventral edges are nearly straight and parallel, the body being of much the same breadth all the way down. The apertures are placed rather far apart, at the ventral and dorsal extremities of the long anterior end of the body. They are sessile and not conspicuous. The branchial is more anterior than the atrial. The surface is uneven and rough, being marked with prominent ridges and grooves, which are chiefly longitudinal, and having here and there sand grains and a few shell fragments attached. The colour is a dark ruddy brown.

The length of the body is 4·4 cm., the greatest breadth of the body is 3 cm., and the thickness is 1·8 cm.

The Test is thin but tough.

The Mantle is very thick, but the musculature is only slightly developed.

The Branchial Sac is strong and rather coarse. It is long and curved with the concavity dorsal. It has four large folds upon each side. The internal longitudinal bars are wide and ribbon-like. There are five or six upon each fold, and two or three only in the interspace. The meshes are much elongated transversely and rather irregular; each contains about twelve stigmata. The transverse vessels are all of much the same size; occasional smaller ones are present for short distances.

The Dorsal Lamina is narrow, and is a perfectly plain membrane with neither ribs nor teeth.

The Tentacles are large and simple; there are about thirty.

The Dorsal Tubercle is elliptical in outline, and is prominent though not large. It lies in a deep triangular peritubercular area, and the horns, which are turned inwards, form two closely placed spirals, each having several turns. The aperture is directed posteriorly, and the longer axis of the tubercle is transverse.

Locality.—Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; depth, 38 fathoms; bottom, sand and shells.

This is an ordinary *Polycarpa* with well-marked family and generic characters, but apparently distinct from any previously described species. The single specimen was obtained in Bass' Straits, from a depth of 38 fathoms. The external form (Pl. XLIX. fig. 1) is not remarkable. It has a leathery Cynthiad test corrugated and somewhat incrusted externally, and having inconspicuous apertures with no well-marked lobes. The mantle is remarkably thick (see Pl. XLIX. fig. 3), but is of a firm gelatinous consistency, and has comparatively few muscle bands.

The coarse branchial sac, although long, is rather narrow, and so leaves a considerable cloaca on the dorsal edge in which the rectum lies (Pl. XLIX. fig. 3). The transverse vessels in the branchial sac are irregular, occasionally branching or uniting. They are supplied with muscle fibres, some of which are continued into the interstigmatic vessels (Pl. XLIX. fig. 2).

The dorsal tubercle is distinctly Cynthiad in its appearance, and resembles that of *Cynthia cerebriformis*, Herdman, where, however, the aperture is lateral, not posterior. The endostyle is very prominent.

The alimentary canal is long and narrow. The œsophagus starts from the dorsal edge of the posterior end of the branchial sac, and runs almost directly ventrally, with merely a slight backward inclination, round the posterior end of the peribranchial cavity, and is attached to the inner surface of the left side of the mantle. There seems to be no marked dilatation representing the stomach (see Pl. XLIX. fig. 3), the œsophagus and intestine being directly continuous; towards the ventral edge of the posterior end the intestine turns anteriorly, then dorsally, and then somewhat posteriorly again, so as to form three-fourths of a circle. This open intestinal loop encloses a pale grey homogeneous looking soft mass (see Pl. XLIX. fig. 3), which is clearly the structure erroneously described as the ovary by Savigny in his *Cynthia mytiligera*,[1] and afterwards shown by R. Hertwig[2] to be merely a thickened fold of the lining membrane of the peribranchial space. The intestine finally runs to the dorsal edge of the body, and turns anteriorly to become the long narrow rectum, which may be traced along the dorsal edge nearly to the atrial aperture (Pl. XLIX. fig. 3). The polycarps are very numerous, and are found on both sides of the body imbedded in the mantle. Their short narrow ducts are all directed towards the atrial aperture (see Pl. XLIX. fig. 3).

This species is allied to *Polycarpa mytiligera*, Savigny,[3] but is readily distinguished from it by the external form, the absence of the stomach, and the condition of the dorsal tubercle.

[1] Mémoires, p. 98, pl. viii. fig. 2[2].

[2] Beiträge zur Kenntniss des Baues der Ascidien, *Jenaische Zeitschr.*, Bd. vii. p. 81.

[3] Mémoires, p. 158, pl. viii. fig. 2.

Polycarpa aspera, n. sp. (Pl. XLVII. figs. 3–5).

External Appearance.—The shape is rudely quadrate, tapering slightly towards the anterior end, and attached by the wider posterior end. The dorsal and ventral edges are slightly rounded, and the lateral compression is slight. The apertures are both placed on the anterior end, and are moderately far apart. They are projecting and conspicuous. The surface is uneven and rough. The colour is a dull opaque grey.

The length and the breadth are about 1 cm. each, and the thickness is rather less.

The Test is tough and leathery.

The Mantle is thick and opaque. The musculature is strong. There are longitudinal and transverse and also oblique muscle bands.

The Branchial Sac is large and has four well-developed folds upon each side. The internal longitudinal bars are strong and very numerous. The transverse vessels are not large. They are of two sizes, and occur the larger and the smaller alternately. The meshes are elongated vertically. The stigmata are wide; there are usually three stigmata in a mesh.

The Dorsal Lamina is a plain narrow membrane with no ribs and no teeth.

The Tentacles are simple and short. They are not numerous. There are at least two sizes which alternate with regularity. The larger tentacles are stout and rather inflated.

Locality.—Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2.

This species is formed for a single small specimen obtained off the east coast of South America, at a depth of 600 fathoms. It is attached by the posterior end, and the test is expanded at the sides to form a spreading margin (Pl. XLVII. fig. 3). The mantle is not attached to the test. The muscle bands form a dense network.

The folds in the branchial sac are large and closely placed. There are many internal longitudinal bars upon each fold, and they are placed close together. These internal longitudinal bars may be considerably corrugated, as they are in the case of *Styela bythia* (see Part I., Pl. XVIII. fig. 6). In some places the branchial sac of this species shows irregularities. There are a great number of connectives running between the mantle and the branchial sac; some of them are very long and slender.

The tentacles are of two sizes which occur regularly, and there are also a number of intermediate very minute ones which present indications of being of a third and fourth order, and alternate regularly with those of the first and second (see Pl. XLVII. fig. 5).

The stomach is fusiform, and has its wall thrown into a large number of closely placed longitudinal folds. The intestine is long and is rather convoluted in its course. The anus has an everted lobed margin.

There are numbers of polycarps and endocarps upon both sides of the body. The polycarps are rather long and narrow. The endocarps are very numerous.

Family Ascidiidæ.

To this group belong two species, of which one (*Ciona aspera*, n. sp.) was collected during the Challenger Expedition at Japan, while the other (*Ascidia scabra* (?), O. F. Müller) was dredged during the cruise of the "Porcupine" off the coast of Ireland.

Ascidia scabra (?), O. F. Müller (Pl. XLVII. fig. 11).

One specimen, which probably belongs to this species, was obtained during the first cruise of the "Porcupine," in the summer of 1869, off the coast of Galway, at lat. 53° 10′ N. and long. 9° 19′ W., from a depth of 15 to 20 fathoms. It is about 1·5 cm. in length, and differs from typical examples of *Ascidia scabra* in having an extraordinarily long atrial siphon (Pl. XLVII. fig. 11, *at*), about 5 mm. in length. The surface of the test is smooth.

The branchial sac is in rather bad condition, and the internal longitudinal bars are very narrow. There are no papillæ. In other respects the specimen agrees fairly well with ordinary British specimens of *Ascidia scabra*.

Ciona aspera, n. sp. (Pl. XLIX. figs. 11–13).

External Appearance.—The general shape is irregularly cubical, and the body is not compressed laterally. The anterior extremity is truncated and much corrugated. The posterior end is wide and evenly rounded, there being no adhering prolongations of the test in this region. The body is attached to an Annelid tube near the middle of each side. The apertures are both anterior, being placed close together near the centre of the truncated anterior extremity; they are much contracted. The surface is very irregular, and is covered with short sharp-pointed projections, which are especially developed at the posterior end. The colour is light grey.

The length of the body is 1·5 cm., the breadth is 1·7 cm.

The Test is thin and transparent except at the points of attachment on the right and left sides, and at the anterior end where it is irregularly thickened.

The Mantle is very muscular on the anterior part of the body, and moderately so along the dorsal and ventral edges and round the posterior end. It is thin and almost destitute of muscles on the posterior parts of the two sides. The sphincters around the apertures are strong, and from under them, upon each side of the body, spring five powerful longitudinal muscle bands.

The Branchial Sac is moderately strong. The transverse vessels are all of much the same size, and are rather wide. The internal longitudinal bars are strong and bear stout papillæ at the angles of the meshes, and also intermediate ones. The latter are joined, like the chief papillæ, by delicate horizontal membranes which divide the meshes

transversely. The meshes are square or slightly elongated longitudinally, and contain four to six stigmata each.

The Dorsal Tubercle is small and circular in outline. It lies in a nearly symmetrical peritubercular area.

Locality.—Station 233A, May 19, 1875; lat. 34° 38′ N., long. 135° 1′ E.; depth, 50 fathoms; bottom, sand.

This species is closely allied to the common and widely distributed *Ciona intestinalis*. A single specimen was dredged off Kobé, Japan, from a depth of 50 fathoms, the same locality in which *Ciona savignii* was found (see Part I. p. 236).

The body, as figured and described above, is evidently greatly contracted, especially at the anterior end (Pl. XLIX. fig. 11). Probably when living and expanded in sea water it would attain twice its present length, and under these circumstances the points of attachment to the Annelid tubes, which are now nearer the anterior than the posterior end, would be probably about the junction of the middle and posterior thirds of the body. The anterior end when expanded would certainly be much narrower than at present, and probably would be represented merely by the narrow region lying between the apertures. The posterior extremity has probably changed little. The surface would, when the body became expanded, lose much of its irregularity. The anterior corrugations would certainly disappear, but the characteristic roughness due to projections of the test would of course remain. This roughening of the surface distinguishes the test very clearly from that of *Ciona intestinalis* and of *Ciona savignii*, and reminds one of the appearance presented by *Ascidia aspersa*, O. F. Müller.

When the test is removed the body presents a most characteristic appearance (Pl. XLIX. fig. 12). The anterior end is narrow and bears the two apertures. The posterior is very wide, and is evenly rounded like the posterior end of the test. The whole body is thrown into a strong curve having the convexity dorsal, but this is no doubt partially due to the state of contraction of the specimen. The siphons are prominent and the branchial is twice as wide as the atrial. The apertures are distinctly lobed, and the red ocelli are conspicuous. The sphincters surrounding the siphons are strong, and are continued posteriorly as a series of circular bands running round the anterior end of the body for a short distance below the siphons. Behind this point the circular muscles are feebly developed, and they are almost entirely absent on the middle of each side. Along the dorsal and ventral edges and round the posterior end of the body they are rather stronger and run irregularly. The longitudinal muscle bands are very powerful, and are ten in number, five on each side. They are more closely placed ventrally than dorsally, and they approach more nearly to the ventral edge than to the dorsal, the most dorsally placed band being placed near the middle of each side. These longitudinal bands make their appearance from underneath the anterior circular muscles, and run backwards,

curving ventrally as they go, and keeping within the ventral half of each side. About three-fourths of the way back they split up and become lost in the irregular fibres surrounding the posterior end of the body.

At the base of the atrial siphon a red spot is seen distinctly through the muscles of the mantle. This is the pigmented glandular mass, placed on the extremity of the vas deferens, which is sometimes so conspicuous in *Ciona intestinalis*. It has been described in that species by Heller,[1] and more recently by Roule,[2] who regards it as a renal organ.

The branchial sac is very similar to that of *Ciona intestinalis*, and possesses no noteworthy peculiarity. Occasionally, as shown in the figure (Pl. XLIX. fig. 13), one or two stigmata are interrupted where the delicate horizontal membranes connecting the intermediate papillæ cross them, but no small transverse vessels extending the length of a mesh were found.

Several Crustacea were present as commensals in this branchial sac.

[1] Untersuchungen über die Tunicaten des Adriatischen Meeres, II. Abth., *Denkschr. d. k. Akad. d. Wiss. Wien*, Bd. xxxiv. p. 120, 1875.

[2] Roule, Recherches sur les Ascidies Simples des Côtes de Provence, p. 170.

APPENDIX B.

DESCRIPTION OF A NEW SPECIES OF PSAMMAPLIDIUM.

After the greater part of this Report had been printed and the plates finished, I received from the Challenger Office a small bottle containing some sandy masses obtained on the north coast of Australia, which proved on examination to be specimens of a new species of the genus *Psammaplidium*. As it was too late to insert this species in its proper place in the body of the Report, a description of it is given here.

Psammaplidium pyriforme, n. sp.

External Appearance.—The shape of the colony is rudely pyriform. The upper end is wide and usually flattened, while the lower part tapers to a small area of attachment. The sides vary in shape, they may be convex or almost flat. The surface is irregular and rough. The colour is yellowish-grey.

The length is 2 cm., the greatest breadth is 1·3 cm., and the thickness is 1 cm.

The Ascidiozooids are not large. They are placed at right angles to the upper surface of the colony, but do not show any regular arrangement in systems. The body is elongated antero-posteriorly, and the post-abdomen is distinctly separated from the anterior part.

The Test is very stiff and hard but brittle. It is densely crowded with sand-grains and other foreign particles. The matrix is clear and transparent. The test cells are small and inconspicuous.

The Mantle is thick, and the musculature is very strong. The muscle bands run chiefly in a longitudinal direction.

The Branchial Sac is long and narrow. The stigmata are numerous. They are of fair size and are arranged regularly.

The Endostyle is large and conspicuous.

The Tentacles are numerous but rather short. They are all of one size.

The Alimentary Canal forms a narrow loop. The stomach is globular and smooth-walled.

The Post-Abdomen is long and narrow.

Locality.—Station 186, Flinder's Passage, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; depth, 8 fathoms; bottom, coral mud.

Half a dozen specimens of this small species of *Psammaplidium* were dredged between the north end of Australia and New Guinea, from a depth of 8 fathoms. They are sandy masses of a yellowish-grey colour (the colour of the sand grains), and having a more or less pyriform shape. The upper end is always the wider, and the area of attachment is small. In some cases a short stout peduncle is present. In form this species resembles many of the specimens of *Amaroucium variabile* (see fig. 9, *c.*, on p. 217), but differs in its colour and sandy condition. The dimensions given above are those of one of the largest colonies. The smallest ones are about one-fourth of that size.

The upper end of the colony is usually flat, and is irregularly divided into areas by stiff sandy ridges. This may possibly be an indication of systems, but no common cloacal apertures were observed.

The Ascidiozooids are opaque and of a yellowish-brown colour, which is due to the mantle. They are usually 3 or 4 mm. in antero-posterior length, and from 0·5 to nearly 1 mm. in greatest breadth.

The test owes its stiffness and opacity entirely to the very large amount of im bedded sand. The matrix when seen by itself is transparent, and the test cells are not pigmented. There is fully as much sand in this test as in the case of any of the previously described species of the genus (see p. 237).

The muscle bands of the mantle are strong and closely placed. They form almost a continuous muscular investment over the whole body. Although the chief bands are longitudinal, transverse muscle fibres are present in abundance, and are placed with great regularity. The branchial and atrial siphons are well developed but not long. They are both six-lobed, and the lobes are distinct but short and rounded.

The branchial sac is rather opaque, but is well developed. The ciliated cells bounding the stigmata are distinct. The tentacles are stout and closely placed.

The long slender post-abdomen usually has its edges somewhat corrugated. Its musculature is strong, and is entirely longitudinal in direction.

The reproductive organs were not developed in any of the Ascidiozooids examined, and no larvæ were found in the colony.

This species resembles *Psammaplidium subviride* (see p. 244), from Station 142, more than it does any of the other known species of the genus. It is, however, distinctly characterised by its pyriform shape, its colour, which is not at all green, the very strong musculature of the mantle, and the comparatively short stigmata in its branchial sac. The stigmata of *Psammaplidium subviride*, on the other hand, are very long and narrow (see Pl. XXXI. fig. 6, *sg.*).

INDEX.

Where more than one reference is given, the figures in darker type indicate the most important page.

Abdomen, 15, 16, 30, 149, 159, 273.
Abyssal zone, 153, 374.
Adriatic, 310.
Alcyonium digitatum, 63, 279.
Alder, J., 6, 38, 177, 184, 323.
Alimentary Canal, 21, 25, 34, 87, 100, 232, 334.
Amaroucium, 92, 148, 149, 151, 152, 164, 177, 180, 200, **214**, 215, 229, 366, 370, 390, 392.
,, *albidum*, 150, 215, **234**, 354, 359, 364, 368, 372, 376 (Pl. xxvi. figs. 11–12).
,, *colelloides*, 215, **233**, 353, 358, 364, 368, 372, 377, 386 (Pl. xxvii. figs. 9–12).
,, *complanatum*, 215, 219, **221**, 353, 359, 364, 368, 372, 377 (Pl. xxx. figs. 16, 17).
,, *globosum*, 188, 215, **219**, 354, 359, 364, 368, 372, 375, 377, 386 (Pl. xxix. figs. 1–5).
,, *hepaticum*, 215, **229**, 364, 368, 372 (Pl. xxv. figs. 13, 14).
,, *irregulare*, 215, **223**, 225, 356, 361, 364, 368, 372, 377 (Pl. xxx. figs. 1–7).
,, *irregulare*, var. *concinnum*, **225**, 356, 361, 364, 368, 372, 377 (Pl. xxx. fig. 8).
,, *lævigatum*, 198, 199, 215, **231**, 251, 356, 361, 364, 368, 372, 377 (Pl. xxx. figs. 12–15).
,, *nigrum*, 215, **236**, 353, 359, 364, 368, 372, 376 (Pl. xxxi. figs. 17–19).
Amaroucium pallidulum, 215, **226**, 357, 361, 364, 368, 372, 376, 386 (Pl. xxx. figs. 9–11).
,, *proliferum*, 35, 91, 124, 229.
,, *recumbens*, 215, **227**, 356, 361, 364, 368, 372, 377, 386 (Pl. xxix. figs. 13–15).
,, *variabile*, 178, 179, 212, 215, **216**, 217, 223, 228, 353, 354, 359, 364, 368, 372, 375, 377, 420 (Pl. xxix. figs. 7–12).
,, *variabile*, var. *tenerum*, 219, 353, 354, 359, 364, 368, 372, 375, 377 (Pl. xxix. fig. 6).
America, South, 361, 362, 363, 366.
Anatomy, 12, 16.
Anatomy of *Colella pedunculata*, 77.
Anatomy of *Colella thomsoni*, 95.
Ancestral Botryllidæ, 37.
Aplidium, 29, 76, 127, 148, 149, 151, 152, 180, 183, 187, **199**, 200, 214, 229, 242, 366, 383, 390, 392.
,, *asperum*, 200, 238.
,, *crassum*, 201, **207**, 352, 358, 364, 367, 372, 375 (Pl. xxv. figs. 15, 16).
,, *despectum*, 201, **210**, 352, 358, 364, 368, 372, 377, 386 (Pl. xxviii. figs. 11–13).
,, *fallax*, 201, **209**, 364, 368, 372, 375, 383, 386 (Pl. xxviii. figs. 1–4).
,, *fuegiense*, 218, 223.
,, *fumigatum*, 201, **211**, 353, 354, 355, 359, 360, 364, 368, 372, 375, 377 (Pl. xxvi. figs. 8, 9).

Aplidium fuscum, 150, 201, **203**, 206, 353, 359, 364, 367, 372, 375, 377 (Pl. xxviii. figs. 8–10).
„ *incrustans*, **201**, 357, 361, 364, 367, 372, 378 (Pl. xxvii. figs. 3–8).
„ *leucophœum*, 201, 204, **205**, 354, 359, 364, 367, 372, 375, 377 (Pl. xxviii. figs. 5–7).
„ *pedunculatum*, 73, 74, 381.
Appendiculariidæ, 2, 387, 388.
Arrou Islands, 310, 311, 355, 360.
Ascidia, 17, 21, 23, 160, 161.
„ *aspersa*, 417.
„ *scabra*, **416** (Pl. xlvii. fig. 11).
Ascidiæ Compositæ, 13, 17, 22, **28**, 307, 308, 317, 319, 347, 351, 374, 378, 379, 387, 395, 399.
„ Salpiformes (see *Pyrosoma*), 2, 28, 317.
„ Simplices, 1, 2, 5, 13, 17, 18, 20, 22, 28, 29, 92, 163, 205, 208, 238, 243, 306, 321, 323, 325, 326, 328, 332, 334, 344, 346, 351, 379, 383, 384, 387, 391, 396, 397, 399, 401.
„ Sociales (see Clavelinidæ), 29, 30, 325, 341.
Ascidiarium, 12.
Ascidiidæ, 17, 388, 397, 416.
Ascidiozooid, 12, **15**, 16, 28, 32, 34, 35, 40, 43, 44, 46, 77, 81, 95, 138, 149, 151, 169, 346.
Ascopera pedunculata, 403.
Astellium, 307, 309, 313.
„ *spongiforme*, 314.
"Astrolabe," 75, 76.
Atlantic, North, 362, 363, 366.
Atlantic, South, 362, 363, 366.
Atopogaster, 151, 152, **163**, 164, 383, 390, 391, 392.
„ *aurantiaca*, 15, 19, 20, 164, **168**, 172, 208, 251 354, 359, 363, 367, 372, 376.
„ *elongata*, 164, **173**, 175, 176, 224, 225, 232, 356, 361, 363, 367, 372, 376 (Pl. xxiv. figs. 1–8).
„ *elongata*, var. *pallida*, 164, **175**, 352, 358, 363, 367, 372, 375 (Pl. xxiv. figs. 9, 10).
„ *gigantea*, 150, **164**, 356, 361, 363, 367, 372, 376 (Pl. xxiii. figs. 1–6).
„ *informis*, 164, **171**, 230, 363, 367, 372 (Pl. xxiv. figs. 11–15).
Atrial languet, 18, 34, 150.
Atrial tentacles, 331.
Aurantium, 149, 151, 152, 187.
Australia, 116, 307, 323, 362, 411, 419, 420.
Azores, 132.
Bahia, 207, 275, 277, 279, 280, 315, 352, 358, 378.
Balanus, 176.
Barra Grande, Brazil, 137, 352, 358, 386.
Bass Strait, 72, 119, 169, 235, 264, 386, 414.
Bathymetrical distribution, **371**, 374, 378.
Bathyoncus, 19, 153, 155, 383, 401, 407, 408, 410.
„ *discoideus*, 401, **407**, 408 (Pl. xlvii. fig. 6; Pl. xlviii. figs. 5–11).
„ *minutus*, 401, 407, **409** (Pl. xlvii. figs. 7–10).
„ *mirabilis*, 331, 401, 408.
Bay of Naples, 46, 131, 262.
Beneden, E. van, 59, 60, 92, 306.
Bermuda, 50, 144, 145, 266, 351, 352, 357, 378, 383, 386.
Berwick Bay, 209.
Bibliography, 8.
Blood corpuscles, 14, 18, 22, 25, 42, 43, 59, 90.
Bolteninæ, 388, 403.
Botrylli conglomerati, 35.
„ stellati, 35.
Botryllidæ, 13, 14, 17, 18, 21, 22, 23, 24, 25, 30, 31, **33**, 34, 36, 43, 59, 65, 144, 145, 146, 147, 149, 250, 254, 273, 325, 326, 363, 366, 369, 371, 374, 381, 383, 384, 385, 386, 387, 388, 389, 396, 397, 398, 399.
Botrylliens, 6, 15, 17, 30.
Botrylloides, 33, 36, 37, **38**, 39, 40, 43, 46, 49, 54, 56, 60, 61, 62, 64, 166, 220, 241, 290, 366, 374, 381, 397, 398.
„ *fulgurale*, 41, **52**, 60, 192, 363, 367, 371, 374, 378, 385 (Pl. iii. figs. 1–8).
„ *gascoi*, 46, 49.
„ *nigrum*, 41, **50**, 351, 357, 363, 367, 371, 375, 386 (Pl. i. fig. 8; Pl. iii. figs. 19–21).
„ *perspicuum*, 41, **45**, 49, 51, 55, 355, 360, 363, 367, 371, 375 (Pl. i. figs. 4, 5; Pl. iii. figs. 9–14).
„ *perspicuum*, var. *rubicundum*, 41, **48**, 355, 360, 363, 367, 371, 375 (Pl. i. figs. 6, 7; Pl. iii. figs. 15–18).
„ *purpureum*, n. sp. (*i.e.*, *Botrylloides tyreum*, see p. 381), 19, 34, **41**, 47, 49, 54, 67, 344, 381 (Pl. i. figs. 1–3; Pl. ii. figs. 1–11).
„ *rubrum*, 39.

Botrylloides tyreum (= *Botrylloides purpureum*, p. 41), 19, 344, 355, 360, 363, 367, 371, 375, 381, 385.
Botryllus, 5, 12, 15, 29, 33, 34, 35, 36, 37, 38, 40, 42, 53, 56, 61, 62, 63, 92, 166, 182, 220, 225, 344, 381, 397, 398.
„ *conglomeratus*, 35.
„ *polycyclus*, 62.
Branchial lobes, 18, 81, 148, 150, 177, 256, 317, 321, 325.
„ sac, 18, 25, 34, 68, 83, 98, 155, 157, 160, 408.
Brevistellium, 309, 313.
British Ascidian Fauna, 37, 342.
British Museum collection, 251, 252, 253, 283, 324, 338, 339.
Bud, structure of, 25, 59, 102.
Campanularia volubilis, 58.
Cape Verde Islands, 288, 289, 352.
Caroline Islands, 72, 94.
Carpenter, Dr. P. H., 402.
Carpenter, Dr. W. B., 295.
Carus, Dr. V., 323, 325.
Catenatæ, 30.
Cellulophana pileata, 127.
Challenger, new species, 2, 7, 31, 36, 151, 215, 252, 259, 267, 323, 331, 339.
Chandelon, T., 52.
Chausey Archipelago, 6, 214, 253.
Chondrostachys, 6, 31, 32. 70, 72, 127, 393, 394.
Chondrostachyidæ, 31, 70, 73, 127.
Chorizocormus, 325, 326, 327, 342, **345**, 346, 398.
„ *reticulatus*, **346**, 353, 359, 365, 369, 373, 376, 384 (Pl. xlvi. figs. 1–8).
Ciona, 21, 29, 32, 396, 401.
„ *aspera*, **416** (Pl. xlix. figs. 11–13).
„ *intestinalis*, 417, 418.
„ *savignii*, 417.
Circinalium, 148, 149, 151, 152, 177, 390, 392.
Classification, 12.
Clavelina, 29, 32, 70, 323, 325, 388, 389.
„ *oblonga*, 50.
Clavelinidæ, 13, 24, 28, 29, 30, 31, 72, 92, 163, 248, 324, 341, 346, 347, 386, 397.
Cœlocormidæ, 2, 12, 31, **317**, 365, 366, 370, 373, 374, 384, 388, 389, 393, 395.
Cœlocormus, 31, 317, **318**, 393, 394, 395.
„ *huxleyi*, 317, **318**, 319, 320, 365, 369, 373, 374, 378, 384, 385, 386, 387, 399 (Pl. xxxvii. figs. 1–8; Pl. xxxviii. figs. 1–4).
Cœnobium, 13.
Colella, 25, 59, 70, 71, **72**, 73, 89, 127, 133, 134, 144, 154, 189, 191, 192, 233, 330, 366, 369, 374, 381, 382, 386, 387, 393, 394.
„ *concreta*, 23, 73, **123**, 144, 354, 359, 363, 367, 371, 375, 376, 386 (Pl. xvi. figs. 8, 9, 11–16).
„ *elongata*, 73, **110**, 354, 359, 363, 367, 371, 375, (Pl. xvi. figs. 1–7, 10).
„ *gaimardi*, 71, 73, **103**, 357, 361, 363, 367 371, 375, 385, 386 (Pl. xiv. figs. 7–14).
„ *murrayi*, 14, 73, **115**, 119, 120, 134, 354, 359, 363, 367, 371, 374, 377, 382, 385 (Pl. xvii. figs. 1–11).
„ *murrayi*, var. *rubida*, 73, **119**, 354, 359, 363, 367, 371, 375 (Pl. xvii. figs. 12–14).
„ *pedunculata*, 12, 15, 17, 71, 73, **74**, 99, 101, 104, 105, 111, 112, 114, 121, 131, 134, 142, 192, 217, 245, 353, 354, 356, 357, 359, 361, 363, 367, 371, 375, 376, 381, 385, 386 (Pls. v.–ix.)
„ *pulchra*, 73, **106**, 140, 355, 360, 363, 367, 371, 375, 386 (Pl. xv. figs. 1–13).
„ *quoyi*, 73, **113**, 353, 359, 363, 367, 371, 375, 385 (Pl. xiv. figs. 1–6).
„ *ramulosa*, 17, 73, **120**, 144, 356, 361, 363, 367, 371, 374, 377, 385 (Pl. xv. figs. 14–17).
„ *thomsoni*, 12, 71, 73, **94**, 101, 111, 355, 360, 363, 367, 369, 371, 375, 382, 385, 386 (Pls. x.–xiii.)
Colony, 12, 16, 27, 37, 46, 77, 93, 95, 382.
Colony, formation of, in *Colella pedunculata*, 93.
Colony, formation of, in *Colella thomsoni*, 102.
Common cloaca, 13, 16, 18, 32, 34, 35, 38, 40, 43, 47, 256, 257, 319, 320.
Copepoda, 166, 167, 168, 312, 406, 418.
Corella, 160, 161.
Cormus, 12.
Culeolus, 19, 153, 155, 156, 250, 383, 401, 403, 404, 408.
„ *moseleyi*, 404.
„ *murrayi*, 404.
„ *perlatus*, 403, 404, 405.
„ *perlucidus*, 404.
„ *recumbens*, 404.
„ *willemœsi*, **403**, 404 (Pl. xlviii. figs. 1–4).
„ *wyville-thomsoni*, 404.
Cunningham, Dr. R. O., 76, 219, 324, 326, 327, 337, 338, 339, 341.
Cuvier, 5, 29.
Cynthia aggregata, 323.
„ *cerebriformis*, 414.

Cynthia mytiligera, 414.
„ *pallida*, 405, 406.
„ *pallida*, var. *billitonensis*, 406.
„ *papietensis*, 405, 406.
Cynthiidæ, 13, 32, 323, 324, 346, 384, 396, 397, 398, 399, 401, 403, 405, 407.
Cynthinæ, 388, 403, 405.
Cystodytes, 70, 71, 72, 127, **135**, 136, 271, 289, 294, 382, 393, 394, 395.
„ *cretaceus*, 135, 136.
„ *dellechiaiæ*, 135, 136.
„ *draschii*, 70, 135, 136, **137**, 141, 142, 143, 352, 358, 363, 367, 372, 374, 378, 386 (Pl. xix.).
„ *durus*, 136.
„ *philippinensis*, 135, 136, **140**, 355, 360, 363, 367, 372, 375 (Pl. xx.).
Della Valle, 7, 25, 31, 33, 35, 36, 38, 61, 62, 89, 126, 127, 130, 131, 135, 136, 215, 255.
Delle Chiaje, 6, 35, 61, 62.
Deposits on bottom, 379.
Development of *Colella pedunculata*, 90.
Development of *Colella thomsoni*, 101.
Diatoms, 162, 249.
Diazona, 29, 31, 32, 70, 72, 392, 393, 398.
Didemnidæ, 14, 17, 22, 23, 25, 30, 31, 51, 121, 127, **253**, 254, 255, 256, 257, 258, 259, 260, 262, 266, 267, 273, 292, 307, 308, 309, 317, 364, 366, 370, 373, 374, 375, 384, 385, 388, 389, 393, 394, 395, 396, 399.
Didemniens, 6, 15, 17, 30, 254, 257.
Didemnoides, 258, 259, 266, 267.
„ *macroophorum*, 274.
Didemnum, 29, 254, 256, 257, 258, 259, **260**, 261, 266, 267, 286, 313, 317, 393, 395.
„ *aurantiacum*, 261, **264**, 306, 354, 359, 364, 368, 373, 376, 384, 386 (Pl. xxxiii. figs. 1–8).
„ *candidum*, 256.
„ *gelatinosum*, 6, 314.
„ *inarmatum*, 260, 266, 308.
„ *inerme*, 260, 261, **265**, 308, 351, 357, 364, 368, 373, 376 (Pl. xxxiv. figs. 6–7).
„ *savignii*, 19, 23, **261**, 262, 364, 368, 373, 377, 384 (Pl. xxxiv. figs. 1–5).
„ *styliferum*, 91, 92, 127.
„ *tortuosum*, 255, 260, 266, 308.
„ *viscosum*, 256.
Diphasia rosacea, 58.
Diplosoma, 6, 15, 309, **313**, 393, 396.
Diplosoma carnosum, 314.
„ *chamæleon*, 314.
„ *crystallinum*, 314.
„ *macdonaldi*, 314, **315**, 352, 358, 365, 369, 373, 376 (Pl. xlii. figs. 1–4).
„ *pseudoleptoclinum*, 308, 310, 384.
„ *rayneri*, 307, 309, 314.
„ *spongiforme*, 313, 314.
Diplosomidæ, 17, 25, 30, 31, 256, 257, **307**, 308, 309, 312, 365, 366, 370, 373, 374, 384, 388, 389, 393, 395, 396.
Diplosomoides, 267 (where it is a misprint for *Didemnoides*), **309**, 384, 393, 396.
„ *molle*, 308, **310**, 316, 355, 360, 365, 369, 373, 376 (Pl. xlii. figs. 5–16).
Distaplia, 31, 70, 71, 72, 73, 89, 124, **126**, 127, 128, 210, 381, 382, 393, 394.
„ *lubrica*, 127, 128, 130.
„ *magnilarva*, 127, 128, 130, 131, 132.
„ *rosea*, 127, 128, 130, 131, 132, 198.
„ *vallii*, 15, 18, 127, **128**, 131, 132, 355, 360, 363, 367, 371, 375, 382, 386 (Pl. xviii. figs. 1, 2, 4–6).
Distoma, 29, 32, 70, 71, 72, 127, 135, 393, 394, 395.
„ *adriaticum*, 71, 133.
„ *crystallina*, 70.
„ *mucosa*, 71.
Distomidæ, 17, 18, 22, 23, 30, 31, **69**, 72, 73, 127, 133, 134, 135, 144, 145, 148, 189, 191, 192, 198, 254, 317, 330, 363, 366, 369, 371, 374, 381, 383, 384, 385, 387, 388, 389, 390, 392, 393, 394, 395, 396, 397, 398, 399.
Distomus, 5, 29, 135.
Doliolidæ, 387.
Doliolum, 52.
Dorsal lamina, **19**, 34, 44, 85, 98.
Dorsal languets, 19, 86.
Dorsal tubercle, 20, 87, 99.
Ecteinascidia, 32, 161, 325, 388, 389, 396.
Embryonic blastogenesis, 30, 255.
Endocarps, 326.
Endostyle, **19**, 44, 98, 85.
Enteron, 60.
Eucœlium, 29, 256, 257, 258, 259, 260, 393, 395.
„ *hospitiolum*, 255, 256, 259.
„ *parasiticum*, 259.
Europe, 36.
Færöe Channel, 53, 56, 57, 58, 62, 63, 282, 283, 386.
Falkland Islands, 76, 104, 226, 327, 336, 357, 386.
Fiji Islands, 406.

Fleming, 177, 184.
Forbes, E., 177, 184.
Forbes and Goodsir, 6.
Forbes and Hanley, 38, 61.
Fragarium, 148, 149, 151, 152, 177, 390, 392.
„ *elegans*, 178.
Fungulus, 19, 153, 155, 383.
Gærtner, 5, 35.
Ganin, 7, 59.
Gegenbaur, 6.
Gemmation, 1, 6, 7, **24**, 28, 34, 59, 71, 90, 101, 103, 150, 255, 309, 320, 325, 341, 397.
Genus doubtful:—
——— (?) *clava*, **132**, 352, 357, 363, 367, 372, 374, 378 (Pl. xxvii. figs. 1, 2).
——— (?) *pyriformis*, **133**, 353, 359, 363, 367, 372, 375, 386 (Pl. xvi. fig. 17).
——— (?) *ignotus*, **251**, 356, 361, 364, 368, 373, 377 (Pl. xxviii. figs. 14, 15).
Geographical Distribution, **351**, 363, 367, 369.
Giard, 7, 24, 25, 30, 32, 33, 38, 52, 59, 61, 133, 148, 151, 180, 199, 214, 238, 255, 256, 257, 307, 323, 324, 325, 341.
Glandular tubules, 22, 52, 88.
Glomeratæ, 30.
Goodsiria, 324, 325, 326, **327**, 328, 341, 398, 399.
„ *coccinea*, 165, 324, 325, 326, 327, 328, **337**, 356, 357, 361, 365, 369, 373, 376, 377, 384 (Pl. xlv.).
„ *pedunculata*, 326, 327, 328, **335**, 340, 357, 361, 365, 369, 373, 376, 385 (Pl. xliv. figs. 1–3).
„ *placenta*, 325, 326, 327, **328**, 333, 334, 335, 337, 340, 352, 358, 365, 369, 373, 376, 386, 387 (Pl. xliii.; Pl. xliv. figs. 4, 8–10).
„ *placenta*, var. *fusca*, 328, **333**, 352, 358, 365, 369, 373, 376, 386 (Pl. xliv. figs. 5–7).
Gould, Dr., 94.
Gray, Dr. J. E., 323.
Grube, 61, 62.
Günther, Dr., 53, 253.
Heard Island, 76.
Heart, 22, 88, 100.
Heller, C., 324, 325, 418.
Hertwig, R., 414.
Histology of *Colella pedunculata*, 78.
Histology of *Colella thomsoni*, 96.
History, 5.
Hypobythius, 388.
Incubatory pouch, 18, 24, 81, 101, 385.
Incubatory pouch in *Colella*, 89.
Infundibulum, 20.
Isle of Man, 209.
Isle of May, 184.
Japan, 36, 302, 360, 401, 404, 408, 417.
Jeffreys, Dr. Gwyn; 66, 295.
Jourdain, 307, 308, 309, 313.
Julin, C., 306.
Kerguelen Island, 36, 76, 113, 124, 134, 154, 159, 178, 181, 185, 188, 198, 204, 206, 212, 216, 219, 220, 222, 236, 248, 294, 305, 327, 346, 347, 352, 353, 359, 362, 384, 386.
King George's Sound, 76.
"Knight Errant" Expedition, 57.
Kowalevsky, 6, 150, 229.
Krohn, 6, 24, 59.
Lamarck, 5, 29, 35, 61, 62, 256.
Larvacea (Appendiculariidæ), 2, 28.
Leptoclinidæ, 276 (misprint for Didemnidæ).
Leptoclinum, 23, 254, 257, 258, 259, 260, 262, **266**, 267, 268, 283, 286, 288, 297, 300, 321, 366, 370, 384, 393, 395.
„ *albidum*, 267, 268, **287**, 288, 289, 292, 352, 357, 358, 365, 368, 373, 376, 377, 384.
„ *albidum*, var. *grande*, 268, **291**, 355, 360, 365, 368, 373, 377 (Pl. xxxv. figs. 11–14).
„ *albidum*, var. *luteolum*, 267, 268, 288, 289, **290**, 292, 365, 368, 373, 376, 386 (Pl. xl. figs. 10–15).
„ *annectens*, 268, **280**, 283, 286, 352, 358, 365, 368, 373, 376 (Pl. xxxiv. fig. 14; Pl. xxxviii. figs. 5–9).
„ *carpenteri*, 259, 268, **296**, 298, 299, 300, 365, 368, 373 (Pl. xli. figs. 1–4).
„ *edwardsi*, 267, 268, **300**, 353, 358, 365, 369, 373, 377 (Pl. xxxix. figs. 12–15).
„ *jacksoni*, 259, 267, 268, 302, **303**, 354, 359, 365, 369, 373, 376, 386 (Pl. xxxviii. figs. 19–22).
„ *japonicum*, 259, 268, **302**, 304, 356, 360, 365, 366, 369, 373, 377 (Pl. xxxix. figs. 1–7).
„ *jeffreysi*, 268, **295**, 365, 368, 373, 376 (Pl. xl. figs. 6–9).
„ *maculatum*, 262.

Leptoclinum moseleyi, 267, 268, **272**, 355, 360, 364, 368, 373, 376, 384, 396 (Pl. xxxvii. figs. 9–14).
,, *neglectum*, 268, **286**, 365, 368, 373 (Pl. xxxviii. figs. 10–13).
,, *propinquum*, 267, 268, **284**, 286, 356, 361, 365, 368, 373, 377 (Pl. xxxix. figs. 16–20).
,, *rubicundum*, 259, 268, **305**, 353, 359, 365, 369, 373, 376, 377, 384 (Pl. xxxiii. figs. 9–15).
,, *speciosum*, 23, 255, 268, **274**, 278, 279, 280, 352, 358, 365, 368, 373, 376 (Pl. xxxvi. figs. 1–8).
,, *speciosum*, var. *asperum*, 268, **277**, 279, 352, 358, 365, 368, 373, 376 (Pl. xxxiv. figs. 8–13; Pl. xxxvi. fig. 9).
,, *subflavum*, 268, 289, **293**, 353, 359, 365, 368, 373, 376 (Pl. xxxviii. figs. 14–18).
,, *tenue*, 268, 280, **281**, 282, 284, 285, 286, 287, 301, 356, 357, 361, 365, 368, 373, 375, 377, 378, 386 (Pl. xxxix. figs. 8–11; Pl. xl. fig. 3–5).
,, *tenue*, var. *magnizooidium*, 268, 282, **284**, 365, 368, 373 (Pl. xl. figs. 1, 2).
,, *thomsoni*, 15, 267, 268, 274, 296, **298**, 365, 368, 373 (Pl. xli. figs. 1, 5–7).
,, *tonga*, 268, **269**, 354, 360, 364, 368, 373, 376, 382, 384 (Pl. xxxv. figs. 1–10).
Lissoclinum, 257.
Lissoclinum aureum, 257.
,, *tenerum*, 257.
Lister, J. J., 6.
Loch Foyle, 209, 386.
Macdonald, J. D., 6, 72, 307, 313.
Macroclinum, 149.
,, *crater*, Verrill, 149.
Macrocystis pyrifera, 134.
Malay Archipelago, 362, 363, 366, 406.
Mantle, **17**, 80, 97, 163.
Marginal tubes, 59.
Marion Island, 184, 185, 353, 358.
Mauritius, 149.
Mediterranean, 386.
Metschnikoff, 6, 24, 59.
Milne-Edwards, H., 6, 15, 25, 29, 30, 35, 38, 39, 59, 61, 148, 151, 177, 180, 214, 254, 300.
Molgula, 401, 402, 403.
,, *carpenteri*, **401**, 403 (Pl. xlvii. figs. 1, 2).
,, *chrystallina*, 402.
,, *gigantea*, 165, 343.
,, *occulta*, 402.
,, *pedunculata*, 403.
Molgulidæ, 388, 398, 401, 403.
Monocynthiæ, 324.
Morchellioides, 151, 152, 163, **176**, 177, 180, 383, 390, 392.
,, *affinis*, 18, 150, **177**, 180, 182, 185, 354, 359, 363, 367, 372, 375, 376, 383, 387, 392 (Pl. xxiv. figs. 16–20).
Morchellium, 149, 151, 152, 163, 176, 177, **180**, 390, 392.
,, *argus*, 180.
,, *giardi*, 178, 180, **181**, 184, 185, 204, 353, 359, 363, 367, 372, 375, 376, 383 (Pl. xxv. figs. 1–3).
Murray, Mr., 57.
Muscle-fibres, 14, 17, 43, 139.
"Nassau," 76, 219, 324, 327, 338.
Nephtheis (?), 94.
Nervous system, **20**, 87, 99.
Neural gland (Hypophysis cerebri), 20, 60, 99.
Newfoundland Banks, 149.
Nova Scotia, 211, 351, 386.
Oculinaria, 323, 324, 325, 326, 341.
,, *australis*, 323.
Oligosomidæ, 307.
Olivi, 215.
Oxycorynia, 31, 32, 70, 72, 73, 127, 381, 393, 394.
,, *fascicularis*, 94.
Pacific, North, 362, 363, 366.
Pacific, South, 362, 363, 366.
Pallas, 35.
Parascidia, 148, 151, 152, 177, 184, 390, 392.
,, *flabellata*, 184.
,, *flemingii*, 184.
,, *forbesii*, 184.
Patagonia, 121, 282, 318, 362, 386.
Pectunculus, 235.
Peduncle, 27, 80, 97, 102, 121, 149.
Peripharyngeal band, 20, 86, 99.
Peritubercular area, 20.
Perophora, 29, 52, 92, 388, 389.
Pharyngodictyon, 151, **152**, 156, 374, 383, 390, 391.

Pharyngodictyon mirabile, 19, 149, **153**, 157, 353, 358, 363, 367, 372, 374, 378, 383 (Pl. xxi.).
Philippine Islands, 36, 42, 46, 48, 73, 94, 127, 129, 141, 212, 272, 292, 342, 343, 355, 360, 366, 381, 386.
Phylogeny, 28, 32, 37, 161, 381, 384, **387**, 399.
Pigment cells, 14, 18, 46, 51, 117, 118, 128, 130, 132, 382.
Polycarpa, 324, 325, 326, 412, 414.
„ *aspera*, **415** (Pl. xlvii. figs. 3–5).
„ *bassi*, **413** (Pl. xlix. figs. 1–3).
„ *longisiphonica*, **412**, 413 (Pl. xlix. figs. 4–6).
„ *mytiligera*, 414.
Polycarps, 326, 328, 332, 333, 335, 337, 340, 344, 385.
Polyclinidæ, 13, 14, 17, 18, 22, 23, 24, 30, 31, 70, **148**, 149, 151, 152, 153, 155, 157, 163, 164, 186, 187, 191, 192, 194, 199, 200, 214, 215, 233, 237, 253, 266, 317, 363, 366, 369, 372, 374, 383, 385, 386, 388, 389, 390, 391, 392, 393, 395, 396, 399.
Polycliniens, 6, 15, 17, 30, 31, 148.
Polyclinoides, 149, 150, 151, 152, 164, 214, 390, 392.
„ *diaphanum*, von Drasche, 150.
Polyclinum, 29, 148, 149, 150, 151, 152, 164, 183, **186**, 187, 199, 366, 374, 390, 391.
„ *depressum*, 187, **193**, 355, 360, 364, 367, 372, 375 (Pl. xxvi. figs. 5–7).
„ *fungosum*, 187, **190**, 203, 354, 359, 364, 367, 372, 375, 386 (Pl. xiv. figs. 15–23).
„ *incertum*, 187, **196**, 356, 361, 364, 367, 372, 377 (Pl. xxvi. fig. 10).
„ *minutum*, 18, 187, **197**, 353, 359, 364, 367, 372, 375, 377 (Pl. xxv. figs. 10–12).
„ *molle*, 150, 187, **194**, 203, 357, 361, 364, 367, 372, 378, 386 (Pl. xxv. figs. 7–9).
„ *pyriforme*, 164, 187, **188**, 354, 359, 364, 367, 372, 375, 377 (Pl. xxvi. figs. 1–4).
Polycyclus, 29, 33, 35, 36, 37, 38, 39, 56, **61**, 62, 63, 67, 374, 397, 398.
„ *cyaneus*, 20, 62.
„ *elongatus*, 62.
„ *jeffreysi*, 62, **66**, 363, 367, 371, 375, 385, 394 (Pl. iv. figs. 6–11).
„ *lamarcki*, 62, **63**, 67, 68, 69, 363, 367, 371, 378 (Pl. iv. figs. 1–5).
„ *renierii*, 62.
„ *violaceus*, 62, 65.
Polycynthiæ, 324.
Polystyela, 31, 324, 326, 341, 346, 398.
„ *lemirri*, 324, 345.
Polystyelidæ, 2, 12, 17, 31, 32, **322**, 324, 325, 326, 327, 346, 348, 365, 366, 370, 373, 374, 381, 384, 385, 387, 388, 389, 398, 399.
"Porcupine" and "Lightning" Collections, 2, 36, 41, 53, 56, 58, 62, 63, 67, 127, 130, 209, 282, 284, 288, 290, 295, 296, 298, 369, 401, 402, 416.
Port Jackson, 36, 111, 191, 239, 304, 354, 378, 386, 412.
Port Western, 76.
Post-abdomen, 15, 16, 30, 149, 151, 159, 162, 175.
Prebranchial zone, 20, 86.
Protandry, 23, 385.
Proto-Ascidiacea, 388.
Proto-Chordata, 388.
Protogyny, 23, 45, 56, 69, 100, 385.
Proto-Thaliacea, 387, 388.
Proto-Tunicata, 387, 388, 389.
Psammaplidium, 13, 150, 151, 152, **237**, 238, 366, 383, 390, 392, 419, 420.
„ *effrenatum*, 149, 238, **241**, 357, 361, 364, 368, 372, 378 (Pl. xxxii. figs. 6, 7).
„ *exiguum*, 238, **245**, 352, 358, 364, 368, 373, 377, 386 (Pl. xxxi. figs. 11, 12).
„ *flavum*, 238, **249**, 357, 361, 364, 368, 373, 378 (Pl. xxxii. figs. 11–13).
„ *incrustans* (= *Psammaplidium effrenatum*), 238.
„ *ovatum*, 238, **246**, 355, 360, 364, 368, 373, 376 (Pl. xxxi. figs. 13–16).
„ *pyriforme*, 238, 251, 355, 360, 364, 368, 373, 376, **419**.
„ *retiforme*, 238, **248**, 353, 359, 364, 368, 373, 377, 386 (Pl. xxxii. figs. 8–10).
„ *rude*, 238, **242**, 364, 368, 372 (Pl. xxxi. figs. 1–4).
„ *spongiforme*, 238, **239**, 247, 354, 359, 364, 368, 372, 376 (Pl. xxxii. figs. 1–5).
„ *subviride*, 238, **244**, 246, 247, 353, 358, 364, 368, 373, 377, 420 (Pl. xxxi. figs. 5–10).
Pseudodidemnum, 307, 309, 313.

Pseudodidemnum crystallinum, 314.
„ *listerianum*, 314.
„ *zosterarum*, 314.
Pyrosoma, 68, 317, 319, 320, 322, 384, 388, 389, 393, 394, 395, 399.
Pyura, 326.
Quoy and Gaimard, 73, 74, 75.
Renal organ, 23.
Renier, 5, 215.
Reproductive organs, **23**, 88, 100, 162, 255, 385, 395.
Respiratory organ in test, 54, 387, 397.
Reticulatæ, 30.
Retractor muscles, 15.
Rhopalæa, 32.
Rondeletius, 5.
Salpa, 52, 395.
Salpidæ, 387.
Sarcobotrylloides, 33, 34, 36, 37, 38, 46, **56**, 58, 62, 374, 397, 398.
„ *superbum*, 56, 57.
„ *wyvillii*, 25, 56, **57**, 60, 92, 102, 363, 367, 371, 378, 385, 386, 397 (Pl. iv. figs. 12–18).
Sarcodictyon, 279.
Savigny, 5, 15, 28, 29, 35, 38, 59, 61, 148, 151, 183, 186, 199, 214, 256, 259, 414.
Schlosser and Ellis, 5.
Scilly Isles, 323.
Sertularia operculata, 58, 63.
Sidnyum, 148, 149, 151, 152, 163, 176, 180, **183**, 199, 390, 392.
„ *pallidum*, 180, 183, **184**, 204, 353, 358, 367, 364, 372, 376, 383 (Pl. xxv. figs. 4–6).
„ *turbinatum*, 177, 183, 184.
Sigillina, 29, 70, 148, 149, 151, 152, 164, 200, 214, 390, 392.
Simon's Bay, and Cape of Good Hope, 154, 175, 185, 233, 245, 246, 279, 288, 289, 301, 329, 333, 352, 358, 362, 378, 386, 406.
Sluiter, Dr. C., 389, 406.
Southern Ocean, 362, 363, 366.
Sphincters, 17, 82.
Spicules, 14, 133, 135, 138, 139, 142, 255, 256, 260, 263, 270, 271, 273, 308, 382, 395.
Stigmata, 19, 25, 34, 44, 83, 98.
Stomach, 21, 22, 163, 176, 179, 187, 255, 276, 337.
Strait of Magellan, 76, 165, 173, 219, 223, 228, 231, 251, 282, 283, 285, 324, 327, 338, 342, 343, 345, 362, 384, 386.
Styela, 156, 324, 325, 334, 344, 345, 348.
„ *bythia*, 415.
„ *grossularia*, 412.
„ *pusilla*, 411 (Pl. xlix. figs. 7–8).
„ *radicosa*, 410, 411 (Pl. xlix. figs. 9–10).
Styelinæ, 324, 334, 344, 388, 398, 403, 407.
Suhm, Dr. R. v. Willemoes, 403.
Sulu Sea, 94.
Symplegma, 18, 70, 71, 72, **144**, 383, 388, 397, 398.
„ *viride*, **144**, 351, 357, 363, 367, 372, 375 (Pl. xviii. figs. 7–14).
Synascidiæ, 258, 399.
Synoicum, 148, 149, 151, 152, 163, 176, 180, 183, 390, 392.
Synstyela, 31, 324, 326, 327, **341**, 342, 398, 399.
„ *incrustans*, 325, 326, 337, **342**, 348, 349, 355, 356, 360, 361, 365, 369, 370, 373, 376, 377, 386 (Pl. xlvi. figs. 9–14).
Synstyela variegata, 324.
System, 13, 16, 24, 34, 35, 37, 38, 40, 43, 56, 60, 124, 149, 166, 249, 396.
Tahiti, 406.
Tailed larva, 6, 52, 61, 89, 101, 105, 109, 130, 131, 134, 140, 147, 171, 173, 193, 196, 210, 211, 227, 229, 246, 249, 265, 283, 304, 320, 322, 333, 335, 345, 385, **386**.
Tangier Bay, 62, 66, 67, 127, 129, 290, 291, 295.
Temperature at bottom, 379.
Tentacles, **20**, 34, 44, 62, 86, 99, 140, 163, 306.
Test, **13**, 16, 32, 34, 35, 40, 43, 78, 96, 237, 308.
Tetradidemnum, 258.
„ *gigas*, 259.
Thaliacea, 2, 28.
Thompson, W., 6.
Thomson, Sir Wyville, 57, 295, 339.
Thorax, 15, 16, 30, 159.
Thylacium, 323, 324, 325, 326, 327, 341, 346, 398.
„ *aggregatum*, 323.
„ *normani*, 323.
„ *sylvani*, 323.
„ *variegatum*, 323, 324, 342.
Tizard, Captain, 57.
Tongatabu, 269, 354, 360.
Torres Straits, 106, 193, 247, 386.
Tridemnum, 257, 258, 260.
„ *benda*, 260.

"Triton" Expedition, 52, 57.
Tylobranchion, 151, 152, **157**, 383, 390, 391.
„ *speciosum*, 17, 19, 20, **157**, 164, 169, 170, 354, 359, 363, 367, 372, 375, 376, 383 (Pl. xxii.).
United States Commission of Fish and Fisheries, 288.
Urochord, 61.
Vascular appendage, 22, 24, 78, 79, 81, 89, 93, 101, 254, 386.
Vas deferens, 23, 394, 395.
Verrill, 257, 288.
Vessels in test, 13, 14, 17, 24, 25, 34, 43, 46, 59, 79, 97, 397.
Vertebrata, relationship with, 6.
Von Drasche, 7, 30, 31, 33, 36, 38, 56, 61, 62, 94, 126, 127, 135, 136, 149, 150, 186, 200, 215, 254, 255, 258, 260, 307, 308.
Wyville-Thomson ridge, 57.

EXPLANATION OF THE PLATES.

The figures were copied from my pencil drawings with the exception of Plates II. and VII., which I drew on stone from the specimens.

Plates I., III.–VI., VIII.–XIII., XVI., XIX., XX., XXII., XXVI., XXXII.–XXXVII., XXXIX.–XLII., and XLIX. were lithographed and printed by Dobb & Co., Liverpool; while plates XIV., XV., XVII., XVIII., XXI., XXIII.–XXV., XXVII.–XXXI., XXXVIII., and XLIII.–XLVIII. were lithographed and printed by Mr. F. Huth, Edinburgh.

It should be stated that some of the anatomical figures (*e.g.*, some of those representing the structure of the Ascidiozooids, and some of the branchial sacs) are "combination figures," formed of portions drawn from several different specimens and pieced together.

The following powers were used in drawing the figures for the plates :—

S. 1 = Swift's 1 inch objective, magnifying about 50 diameters.
S. $\frac{1}{4}$ = „ $\frac{1}{4}$ „ „ 230 „
S. $\frac{1}{6}$ = „ $\frac{1}{6}$ „ „ 330 „
Z. $\frac{1}{12}$ = Zeiss' $\frac{1}{12}$ objective (oil immersion), magnifying about 950 diameters.

LIST OF THE ABBREVIATIONS.

a.	Anus.	*br.f.*	Longitudinal folds in branchial sac.
ab, abd.	Abdomen of Ascidiozooid.	*br.l.*	Branchial lobe.
ad.	Adhering appendage.	*br.n.*	Nerves arising from branchial end of ganglion.
ap.	Appendage from body of Ascidiozooid.	*br.s.*	Branchial sac.
at.	Atrial aperture.	*b.v.*	Blood-vessel.
at.l.	Atrial languet.	*cœ.*	Cæcum of stomach.
at.n.	Nerves arising from atrial end of ganglion.	*c.d.*	Connective duct in the branchial sac.
at.tn.	Atrial tentacles.	*cl.*	Cloacal aperture.
b.c.	Blood-corpuscles.	*d.l.*	Dorsal lamina.
bl.	Bladder cells in test.	*d.t.*	Dorsal tubercle.
br.	Branchial aperture.		

ec. . . Ectoderm.
em., emb. Young buds.
en. . . Endostyle.
en.c. . Endocarp.
end. . Endoderm.
ep. . . Epithelium.
f.d. . . Fold in wall of stomach.
f.p. . . Foreign particle in test.
g. . . Hermaphrodite genital mass.
g.d. . Genital ducts.
gl.n. . Subneural gland.
gm, gm'. . Gemmæ.
h. . . Heart.
h.m. . Horizontal membrane of branchial sac.
h.t. . . Hepatic (?) tubules.
i, i'. . Intestine.
i.l. . . Internal longitudinal bars of branchial sac.
inf. . Infundibulum.
l. . . Languet.
l.s. . . Lower surface of colony.
l.v. . . Fine longitudinal vessels.
m. . . Mantle.
m.b. . Muscle bands.
mes. . Mesoderm.
m.f. . Muscle fibres.
mh. . Meshes of branchial sac.
mh.n. . Narrow mesh.
mh.w. . Wide mesh.
n.g. . Nerve ganglion.
n.gl. . Subneural gland.
n.p. . Incubatory pouch.
n.t. . Neural tube.
o. . . Mature ovum.
o'. . . A young ovum.
o.d. . Oviduct.
œ . . Œsophagus.
ov. . . Ovary.
p. . . Papillæ on the internal longitudinal bars.
p'. . . Small intermediate papillæ.
p.ab., p.abd. Post-abdomen of Ascidiozooid.
p.br. . Peribranchial cavity.
p.c. . Pigment corpuscle.
ped. . Peduncle.
ped.c. . Cavity in the peduncle.
ped.v. . Blood-vessel in the peduncle.
pig. . Mass of pigment cells.
p.p. . Peripharyngeal band.
r. . . Rectum.
sg. . . Stigmata.
sg.c. . Stigmatic or ciliated cells.
sp., sp'. . Spicules.
sph. . Sphincter muscle.
st. . . Stomach.
t. . . Test.
t.c., t.c'. . Small cells in the test.
t.e. . . Terminal enlargement of a blood-vessel.
t.f. . . Fibres in test.
th. . . Thorax of Ascidiozooid.
t.k. . . Terminal knob on vessels.
t.m. . Matrix of test.
tn, tn'. . Large and small tentacles.
tr, tr'. . Large and small transverse vessels.
t.v. . . Spermatic vesicle.
ty. . . Typhlosole.
u.s. . . Upper surface of colony.
v. . . Blood-vessel in test.
v.ap. . Vascular appendage.
v.ap'. . Rudimentary vascular appendage.
v.ap.c. . Canal of vascular appendage.
v.d. . Vas deferens.
ves. . Vesicle of intestinal gland.
z. . . Prebranchial zone.

For 1, 2, 3, and other special symbols see the explanations of the separate plates.

PLATE I.

PLATE I.

Figs. 1–3. *Botrylloides tyreum*,[1] n. sp.
Figs. 4, 5. *Botrylloides perspicuum*, n. sp.
Figs. 6, 7. *Botrylloides perspicuum*, var. *rubicundum*, nov.
Fig. 8. *Botrylloides nigrum*, n. sp.

Fig. 1. A colony of *Botrylloides tyreum*;[1] natural size.

Fig. 2. A small part of the same colony, enlarged, to show the arrangement of the Ascidiozooids.

Fig. 3. A very small part of the same, still more enlarged, to show the structure of the anterior end of the Ascidiozooid.

Fig. 4. A colony of *Botrylloides perspicuum*; natural size.

Fig. 5. A small part of the same colony, enlarged to show the arrangement of the Ascidiozooids in a system, the common cloacal aperture, and the terminal bulbs on the vessels in the test.

Fig. 6. A colony of *Botrylloides perspicuum*, var. *rubicundum*; natural size.

Fig. 7. Another colony of the same variety; natural size.

Fig. 8. A colony of *Botrylloides nigrum*; natural size.

[1] On the plate this species is called *Botrylloides purpureum*. As that name was pre-occupied it has been changed to *Botrylloides tyreum*.

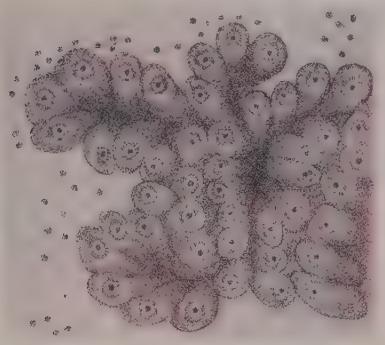


Fig 2.

Fig 1.

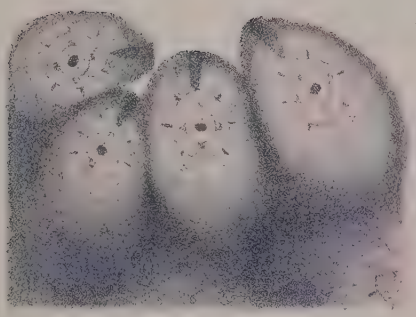
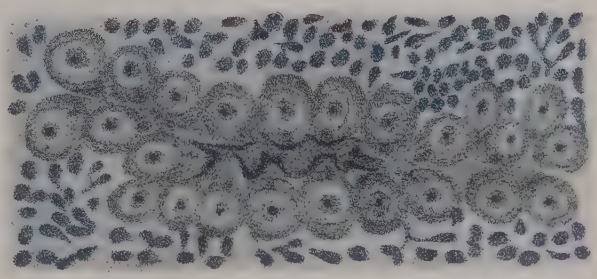


Fig. 3.

Fig. 5.



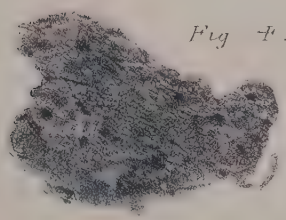


Fig 4.

Fig. 8.

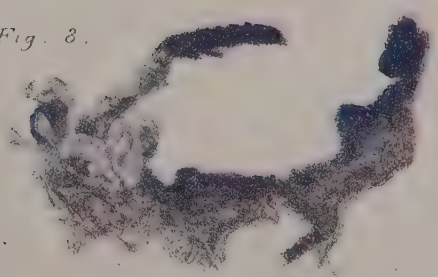


Fig. 7

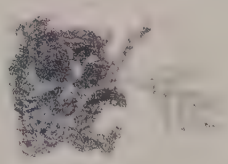


Fig. 6.

FIGS 1-3 BOTRYLLOIDES PURPUREUM, n.sp.
FIGS 4-5 BOTRYLLOIDES PERSPICUUM, n.sp.

FIGS 6-7 BOTRYLLOIDES PERSPICUUM, var RUBICUNDUM n.
FIG 8 BOTRYLLOIDES NIGRUM, n sp

PLATE II.

PLATE II.

Botrylloides tyreum,[1] n. sp.

at.n. Nerves leaving posterior end of ganglion.
b.c. Blood-corpuscle.
br. Branchial aperture.
d.l. Dorsal lamina.
d.t. Dorsal tubercle.
en. Endostyle.
g. Reproductive organs.
gl.d. Duct from neural gland.
i. Intestine.
i.l. Internal longitudinal bar of branchial sac.
l.v. Fine longitudinal vessels of branchial sac.
m. Mantle.
m.b. Muscle band in mantle.
n.g. Nerve ganglion.
o. Ovary.
œ. Œsophagus.
p.p. Peripharyngeal band.
r. Rectum.
sg. Stigmata of branchial sac.
sg.c. Ciliated cells, bounding stigmata of branchial sac.
st. Stomach.
t.c. Test cells.
t.k. Terminal bulb on vessel in test.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
tn, tn'. Tentacles.
v. Vessel in test.
z. Prebranchial zone.

Fig. 1. Part of the test showing the system of vessels and terminal knobs; magnified (S., 1 inch).

Fig. 2. A small portion of the test, more highly magnified, showing a terminal knob filled with blood-corpuscles (S., $\frac{1}{6}$ inch).

Fig. 3. Part of the mantle, showing the muscle bands, their nuclei and other details; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 4. Part of the branchial sac, seen from the inside; magnified (S., 1 inch).

Fig. 5. A small portion of the branchial sac, from the outside; more highly magnified (S., $\frac{1}{6}$ inch).

Fig. 6. The anterior extremity of the endostyle and neighbouring parts; magnified (S., 1 inch).

Fig. 7. An Ascidiozooid, seen from the ventral part of the right side;[2] magnified (S., 1 inch).

Fig. 8. The anterior extremity of an Ascidiozooid, seen from the inside, showing the dorsal lamina, prebranchial zone, tentacles, &c.; magnified (S., 1 inch).

Fig. 9. The dorsal tubercle, nerve ganglion, and neighbouring parts, seen from the outside; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 10. The genital gland of a full grown Ascidiozooid; magnified (S., 1 inch).

Fig. 11. A young Ascidiozooid, not yet fully developed, showing the two large ovaries; highly magnified (S., $\frac{1}{6}$ inch).

[1] Named *Botrylloides purpureum* on plate.

[2] This figure was not reversed on the stone, and consequently the alimentary canal appears upon the wrong side of the branchial sac.

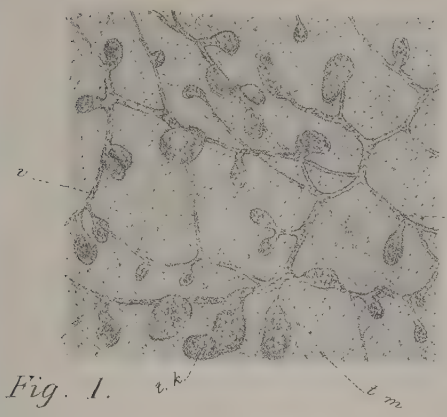
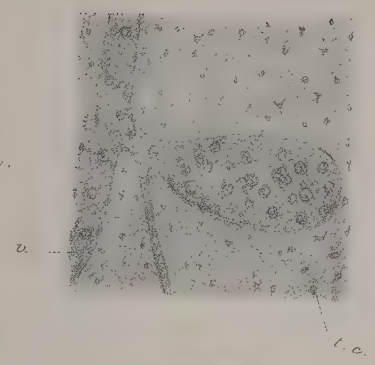


Fig. 1.

Fig. 2.



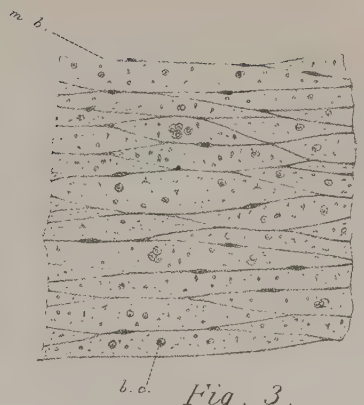


Fig. 3.

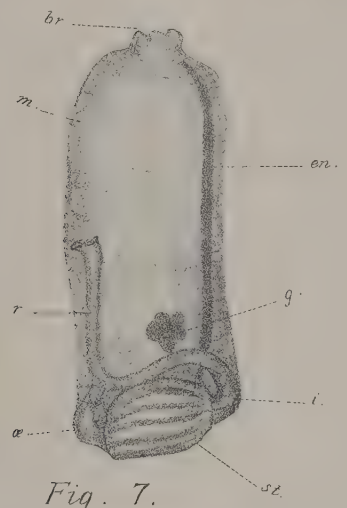


Fig. 7.

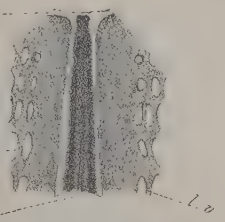


Fig 6.

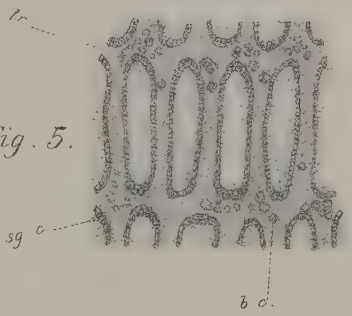
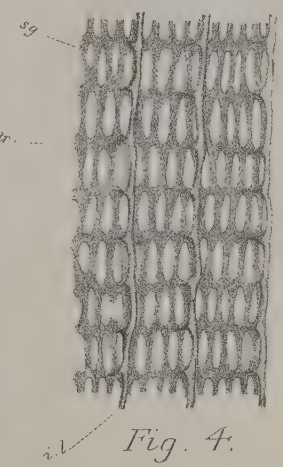


Fig. 5.



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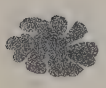
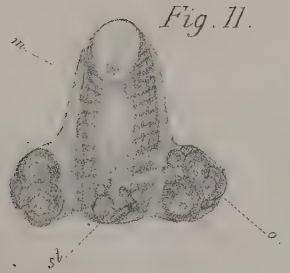


Fig. 10.

Fig. 11.



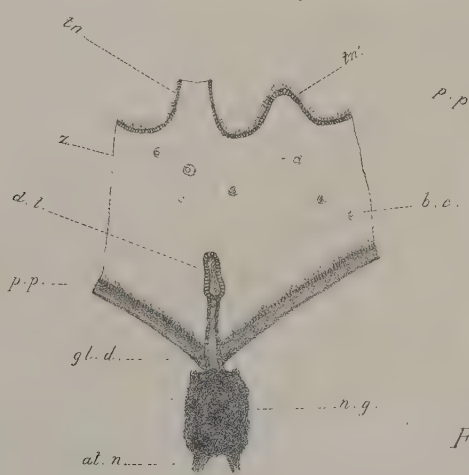


Fig. 9.

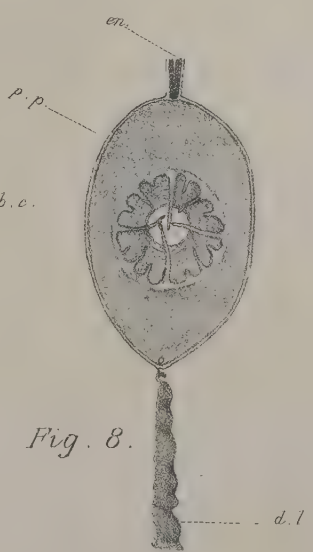


Fig. 8.

PLATE III.

PLATE III.

Figs. 1–8. *Botrylloides fulgurale*, n. sp.
Figs. 9–14. *Botrylloides perspicuum*, n. sp.
Figs. 15–18. *Botrylloides perspicuum*, var. *rubicundum*, nov.
Figs. 19–21. *Botrylloides nigrum*, n. sp.

a. Anus.
br. Branchial aperture.
br.s. Branchial sac.
cæ. Cæcum from stomach.
d.l. Dorsal lamina.
d.t. Dorsal tubercle.
ec. Ectoderm.
en. Endostyle.
gl. Glandular tubules on intestine.
i. Intestine.
i.l. Internal longitudinal bar of branchial sac.
inf. Infundibulum.
l.v. Fine longitudinal vessels of branchial sac.
m.f. Muscle fibre from mantle.
n.g. Nerve ganglion.
n.gl. Neural gland.
œ. Œsophagus.
p.p. Peripharyngeal band.
r. Rectum.
sg. Stigmata of branchial sac.
sph. Sphincter.
st. Stomach.
t.c. Test cells.
t.k. Terminal bulb on vessel in test.
t.m. Test matrix.
tn. Tentacles.
tr. Transverse vessel of branchial sac.
v. Vessel in test.
z. Prebranchial zone.

Fig. 1. A colony of *Botrylloides fulgurale;* natural size.

Fig. 2. Part of the test of *Botrylloides fulgurale;* magnified (S., 1 inch).

Fig. 3. Part of the branchial sac of *Botrylloides fulgurale*, seen from the interior; magnified (S., 1 inch).

Fig. 4. Part of a vertical section through colony of *Botrylloides fulgurale*, showing the anterior part of an Ascidiozooid and the surrounding test; magnified (S., 1 inch).

Fig. 5. Surface view of anterior end of an Ascidiozooid of *Botrylloides fulgurale;* magnified (S., 1 inch).

Fig. 6. The reproductive organs of *Botrylloides fulgurale*, to show the shape; magnified (S., 1 inch).

Fig. 7. Part of the anterior end of an Ascidiozooid of *Botrylloides fulgurale*, showing the tentacles, dorsal tubercle, &c.; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 8. A vertical section through the anterior dorsal region of the Ascidiozooid of *Botrylloides fulgurale*, to show the relations of the nerve-ganglion, the neural gland, and the dorsal tubercle; stained in aniline blue; highly magnified (Z., $\frac{1}{12}$).

Fig. 9. Part of a section through the test of *Botrylloides perspicuum;* magnified (S., 1 inch).

Fig. 10. A small portion of the same section, more highly magnified (S., $\frac{1}{4}$ inch).

Fig. 11. A small part of the branchial sac of *Botrylloides perspicuum;* magnified (S., 1 inch).

Fig. 12. Two pigment cells from *Botrylloides perspicuum;* highly magnified (Z., $\frac{1}{12}$).

Fig. 13. A transverse section through the endostyle of *Botrylloides perspicuum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 14. The alimentary canal of *Botrylloides perspicuum;* magnified (S., 1 inch).

Fig. 15. Part of the branchial sac of *Botrylloides perspicuum*, var. *rubicundum*, seen from the interior; magnified (S., 1 inch).

Fig. 16. Part of the anterior dorsal region of an Ascidiozooid of *Botrylloides perspicuum*, var. *rubicundum* showing the dorsal tubercle and neighbouring parts; highly magnified (S., $\frac{1}{4}$ inch).

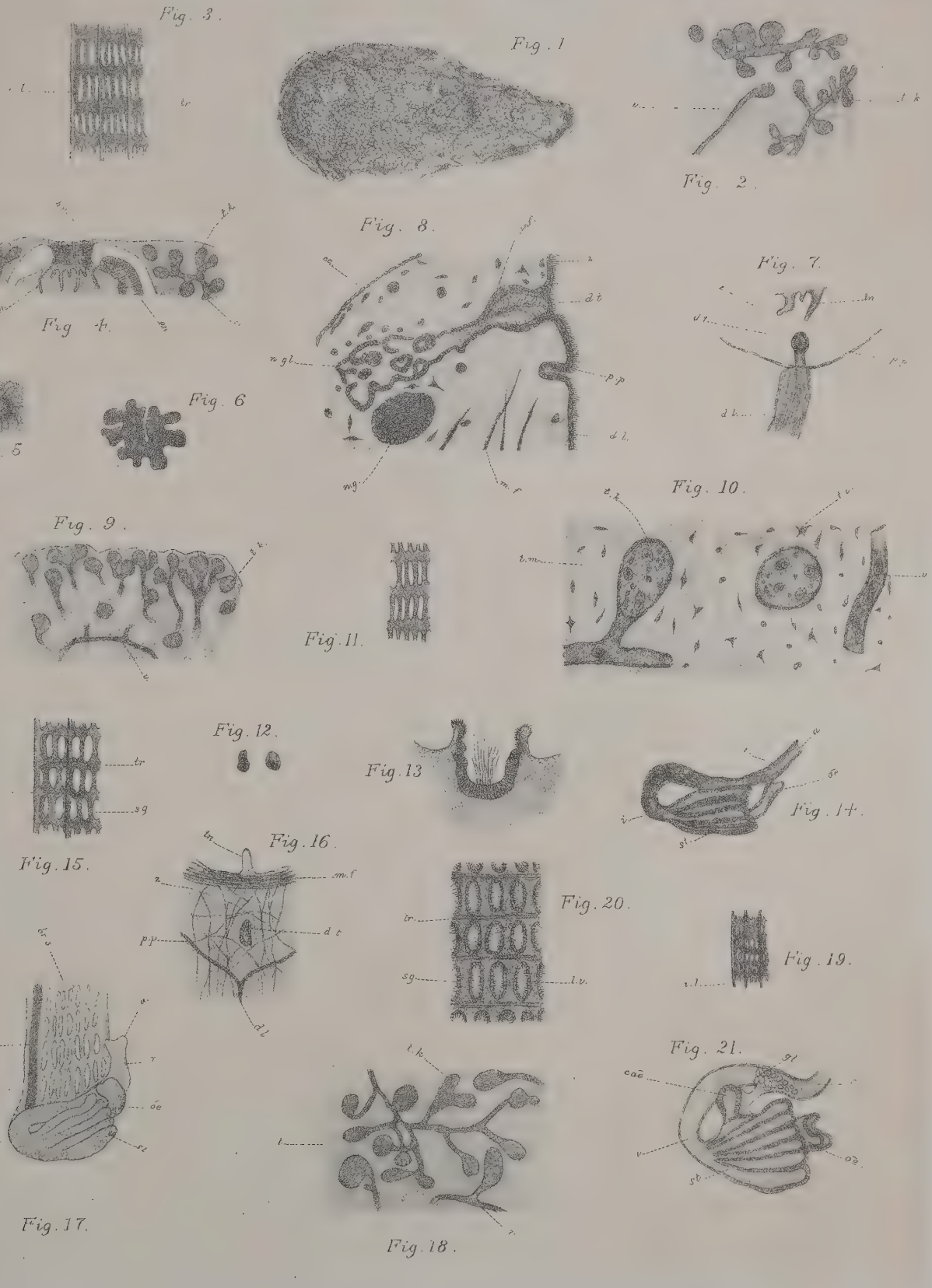
Fig. 17. The branchial sac and alimentary canal of *Botrylloides perspicuum*, var. *rubicundum;* magnified (S., 1 inch).

Fig. 18. Part of the test of *Botrylloides perspicuum*, var. *rubicundum;* magnified (S., 1 inch).

Fig. 19. Part of the branchial sac of *Botrylloides nigrum*, seen from the interior; magnified (S., 1 inch).

Fig. 20. Part of another sac of *Botrylloides nigrum*, seen from the exterior; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 21. The alimentary canal of *Botrylloides nigrum;* highly magnified (S., $\frac{1}{4}$ inch).



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FIGS 1-8 BOTRYLLOIDES FULGURALE, n. sp.

FIGS 9-14 BOTRYLLOIDES PERSPICUUM, n. sp.

FIGS 15-18 BOTRYLLOIDES PERSPICUUM, var. RUBICUNDUM, n

FIGS 19-21 BOTRYLLOIDES NIGRUM, n. sp.

PLATE IV.

PLATE IV.

Figs. 1–5. *Polycyclus lamarcki*, n. sp.
Figs. 6–11. *Polycyclus jeffreysi*, n. sp.
Figs. 12–18. *Sarcobotrylloides wyvillii*, n. sp.

a. Anus.
at. Atrial aperture.
b.c. Blood-corpuscle.
br. Branchial aperture.
d.l. Dorsal lamina.
d.t. Dorsal tubercle.
en. Endostyle.
gm, gm'. Buds in different stages of development.
i.l. Internal longitudinal bar of branchial sac.
m. Mantle.
n.g. Nerve ganglion.
œ. Œsophagus.
pig. Mass of pigmented cells.
p.p. Peripharyngeal band.
r. Rectum.
sg. Stigmata of branchial sac.
sph. Sphincter.
st. Stomach.
t. Test.
t.k. Terminal bulb on vessel in test.
tn. Tentacles.
tr. Transverse vessel of branchial sac.
v. Vessel in test.
z. Prebranchial zone.

Fig. 1. Colony of *Polycyclus lamarcki;* natural size.

Fig. 2. Anterior part of Ascidiozooid of *Polycyclus lamarcki*, seen from the branchial sac; magnified (S., 1 inch).

Fig. 3. Part of the dorsal region of an Ascidiozooid of *Polycyclus lamarcki;* magnified (S., 1 inch).

Fig. 4. Surface view of the anus of *Polycyclus lamarcki;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Optical section of the anus of *Polycyclus lamarcki;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. Colony of *Polycyclus jeffreysi;* natural size.

Fig. 7. An Ascidiozooid of *Polycyclus jeffreysi*, seen from the right hand side; magnified (S., 1 inch).

Fig. 8. Diagram of the vessels in the test of *Polycyclus jeffreysi;* magnified (S., 1 inch).

Fig. 9. Part of the branchial sac of *Polycyclus jeffreysi*, seen from the interior; magnified (S., 1 inch).

Fig. 10. Anterior part of an Ascidiozooid of *Polycyclus jeffreysi*, seen from the branchial sac; magnified (S., 1 inch).

Fig. 11. The atrial siphon of *Polycyclus jeffreysi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 12. Colony of *Sarcobotrylloides wyvillii;* natural size.

Fig. 13. Vessels from the test of *Sarcobotrylloides wyvillii*, showing the contained buds; magnified (S., 1 inch).

Fig. 14. Part of the branchial sac of *Sarcobotrylloides wyvillii*, seen from the exterior; magnified (S., 1 inch).

Fig. 15. Diagram showing the arrangement of the Ascidiozooids in the test of *Sarcobotrylloides wyvillii;* magnified (S., 1 inch).

Fig. 16. Tailed larva of *Sarcobotrylloides wyvillii*, seen from the dorsal surface; magnified (S., 1 inch).

Fig. 17. Tailed larva of *Sarcobotrylloides wyvillii*, seen from the side; magnified (S., 1 inch).

Fig. 18. Portion of the tail of the larva of *Sarcobotrylloides wyvillii*, showing the large cells forming the urochord; highly magnified (S., $\frac{1}{4}$ inch).

Fig 1.

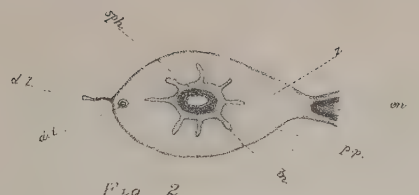


Fig 2.

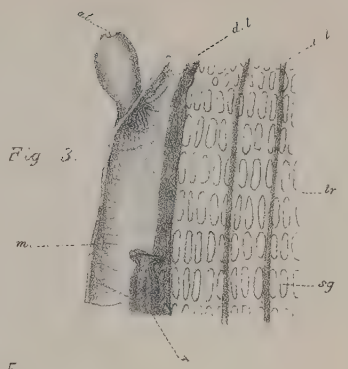
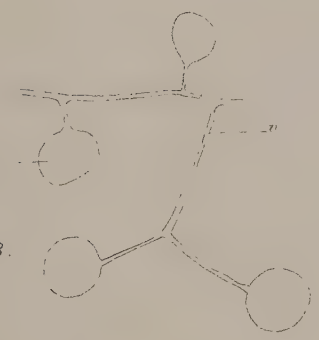


Fig 3.

Fig. 4.

Fig 5.



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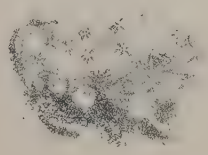


Fig 6.

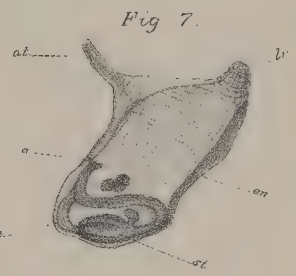


Fig 7.

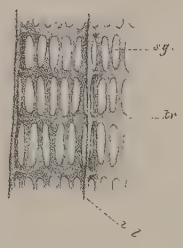


Fig. 9.

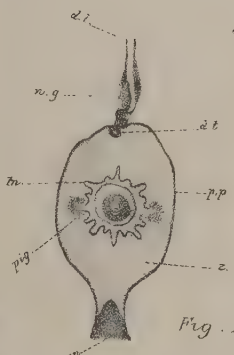


Fig. 10.

Fig. 11.

Fig. 12.

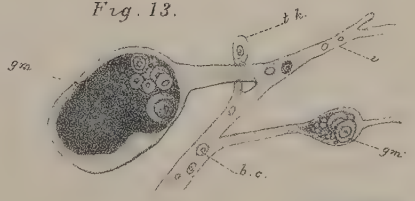


Fig. 13.

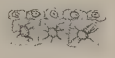
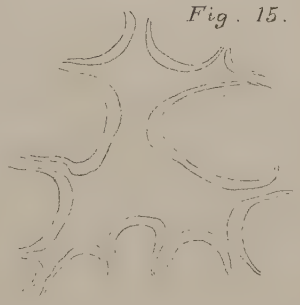


Fig 18.



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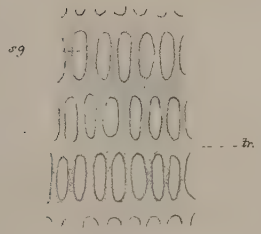


Fig. 14.

Fig 17.

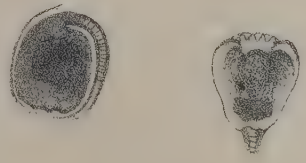


Fig. 16.

FIGS 1–5. POLYCYCLUS LAMARCKI, n. sp.
FIGS 6–11. POLYCYCLUS JEFFREYSI, n. sp.
FIGS 12–18. SARCOBOTRYLLOIDES WYVILLII, n. sp.

PLATE V.

PLATE V.

Colella pedunculata, Quoy and Gaimard.

at. Atrial aperture.	*i.* Intestine.	*st.* Stomach.
br. Branchial aperture.	*n.p.* Incubatory pouch.	*v.ap.* Vascular appendage.
en. Endostyle.	*o.* Ovary.	

Fig. 1. Colony of *Colella pedunculata*, Quoy and Gaimard; natural size.

Fig. 2. Head of another colony of *Colella pedunculata;* natural size.

Fig. 3. Part of head of another colony of *Colella pedunculata;* natural size.

Fig. 4. Lower end of peduncle of *Colella pedunculata;* natural size.

Fig. 5. Lower end of peduncle of another colony of *Colella pedunculata;* natural size.

Fig. 6. Vertical section of head of *Colella pedunculata;* natural size.

Fig. 7. Transverse section through upper end of head of *Colella pedunculata;* natural size.

Fig. 8. Transverse section through middle of head of *Colella pedunculata;* natural size.

Fig. 9. Transverse section through lower end of head of *Colella pedunculata;* natural size.

Fig. 10. Part of the peduncle of *Colella pedunculata;* slightly enlarged.

Fig. 11. Some Ascidiozooids from the head of *Colella pedunculata;* natural size.

Fig. 12. Some incubatory pouches from the head of *Colella pedunculata;* natural size.

Fig. 13. An Ascidiozooid of *Colella pedunculata*, with the incubatory pouch, seen from the left hand side; magnified (S., 1 inch).

Fig. 14. Part of the test from the head of *Colella pedunculata;* magnified (S., 1 inch).

Fig. 15. Small part of the test from the head of *Colella pedunculata;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 16. Part of a section of the test of *Colella pedunculata*, from the centre of the head; magnified (S., 1 inch).

Fig. 17. Part of a section of the test of the outer part of the head of *Colella pedunculata*, showing the outer surface; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 18. Some of the large branched cells from the test of *Colella pedunculata;* highly magnified (Z., $\frac{1}{12}$).

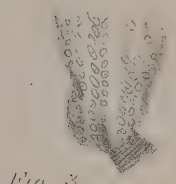
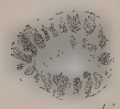


Fig. 3.

Fig. 2.

Fig. 1.

Fig. 7



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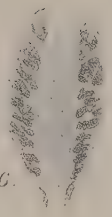

Fig. 6.

Fig. 9.

Fig. 4.

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Fig. 11.

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Fig. 10.

Fig. 13.

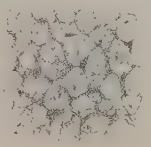
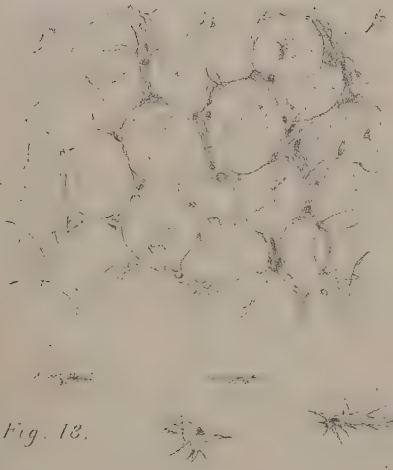


Fig. 14.

Fig. 15.

Fig. 16.



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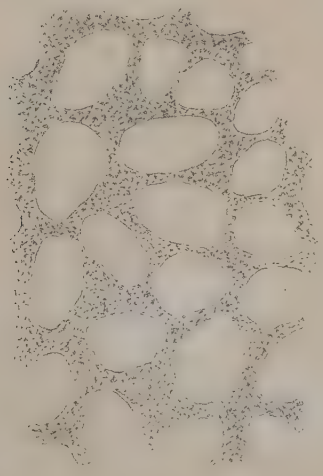

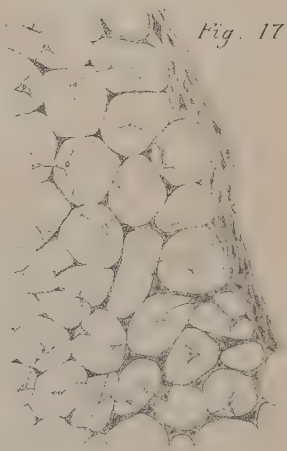

Fig. 17.

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COLELLA PEDUNCULATA, Quoy and Gaimard

PLATE VI.

PLATE VI.

Colella pedunculata, Quoy and Gaimard.

br. Branchial aperture.
en. Endostyle
l.v. Fine longitudinal vessels of branchial sac.
m. Mantle.
m.b. Muscle band in mantle.
n.g. Nerve ganglion.
p.p. Peripharyngeal band.
sg. Stigmata of branchial sac.
sg.c. Ciliated cells bounding stigmata of branchial sac.
sph. Sphincter.
t. Test.
tr. Transverse vessel of branchial sac.

Fig. 1. Part of the surface layer of test of *Colella pedunculata*, showing the apertures; magnified (S., 1 inch).

Fig. 2. Part of the anterior end of an Ascidiozooid, showing the branchial siphon; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 3. Part of the anterior end of an Ascidiozooid, from the left side, showing the branchial siphon in a contracted condition; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Part of the thorax of an Ascidiozooid, seen from the right side and ventral edge; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Part of the mantle of *Colella pedunculata*, showing the muscle bands, from a young Ascidiozooid; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 6. Part of the mantle of *Colella pedunculata*, from an adult Ascidiozooid; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 7. Part of the mantle of the incubatory pouch, showing the ectoderm; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 8. One of the ectoderm cells, showing the long process which runs into the test; more highly magnified (Z., $\frac{1}{1^{1}2}$).

Fig. 9. Part of the squamous epithelium lining the mantle, seen in surface view; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 10. Part of the branchial sac; magnified (S., 1 inch).

Fig. 11. A small part of the branchial sac; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 12. A small part of one of the fine longitudinal vessels of the branchial sac, showing the ciliated cells bounding the stigmata; more highly magnified (S., $\frac{1}{6}$ inch).

Fig. 13. A small part of a fine longitudinal vessel from another branchial sac, showing a different shape of ciliated cell on the stigmata; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 14. The side of one of the fine longitudinal vessels, seen from one of the stigmata; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 15. A transverse section of two of the fine longitudinal vessels from the branchial sac; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 16. Part of a branchial sac of a young Ascidiozooid; highly magnified (S., $\frac{1}{4}$ inch). D.L. indicates the dorsal and En. the ventral edge.

Fig. 17. A small part of a young branchial sac; more highly magnified (S., $\frac{1}{6}$ inch).

Fig. 18. The dorsal part of the branchial sac of a young Ascidiozooid; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 1.

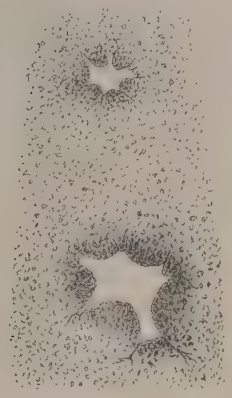


Fig. 2.

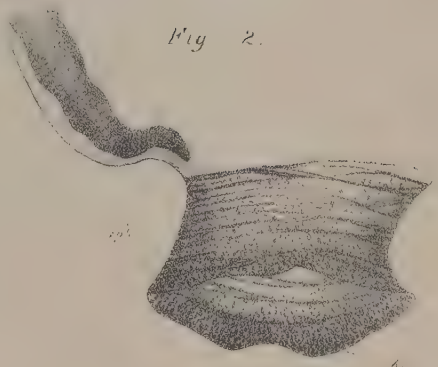
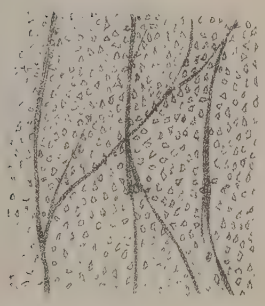


Fig. 3

Fig. 5



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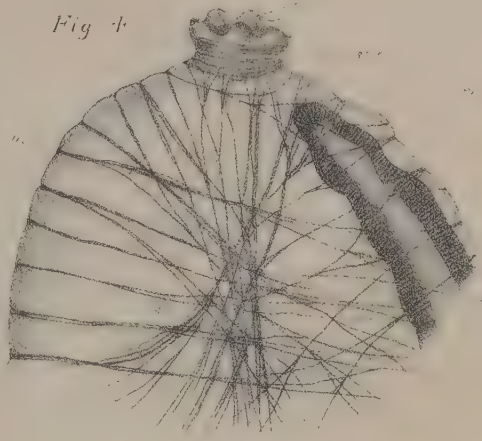


Fig. 6.

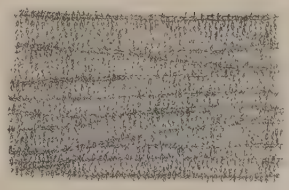


Fig. 7

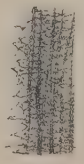


Fig. 10.

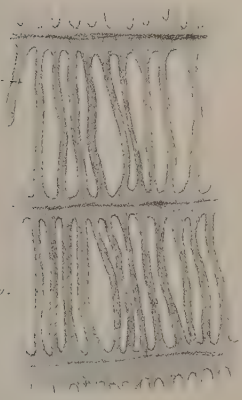


Fig. 11.

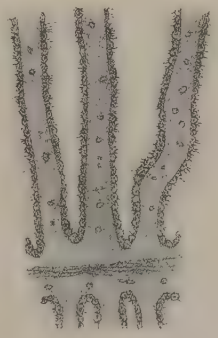


Fig. 9.

Fig. 8.

Fig. 12.

Fig. 13.

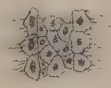


Fig. 14.

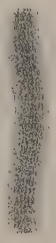
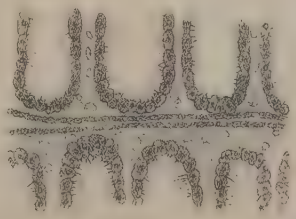


Fig. 15.

Fig. 17.



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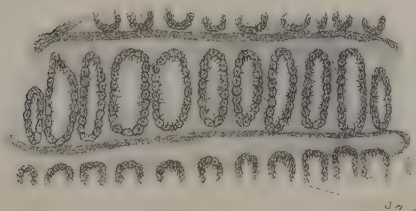

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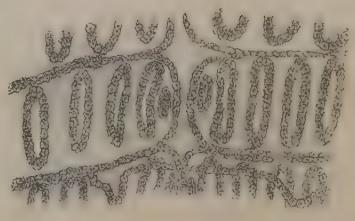
Fig. 16.

Fig. 18



COLELLA PEDUNCULATA, Quoy and Gaimard

PLATE VII.

PLATE VII.

Colella pedunculata, Quoy and Gaimard.

Fig. 1. Section through the test, mantle, and endostyle of an Ascidiozooid; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 2. The anterior end of an Ascidiozooid, seen from the branchial sac; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 3. One of the dorsal languets, seen from the side; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Part of one of the tentacles; more highly magnified (S., $\frac{1}{6}$ inch).

Fig. 5. The nerve ganglion; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. The anterior dorsal region of an Ascidiozooid, showing the dorsal tubercle, tentacles, &c.; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 7. Part of an Ascidiozooid from the right hand side, showing the reproductive organs and incubatory pouch; magnified (S., 1 inch).

Fig. 8. Part of the intestine and the ovary; magnified (S., 1 inch).

Fig. 9. Part of the reproductive organs; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Young ova; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 11. Mature ovum; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 12. Young incubatory pouch with two embryos; magnified (S., 1 inch).

Fig. 13. Older incubatory pouch with a number of embryos and larvæ; magnified (S., 1 inch).

Fig. 14. Fully developed incubatory pouch, with contained embryos and larvæ; magnified (S., 1 inch).

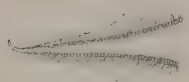


Fig. 3.

Fig. 2.

Fig. 1.

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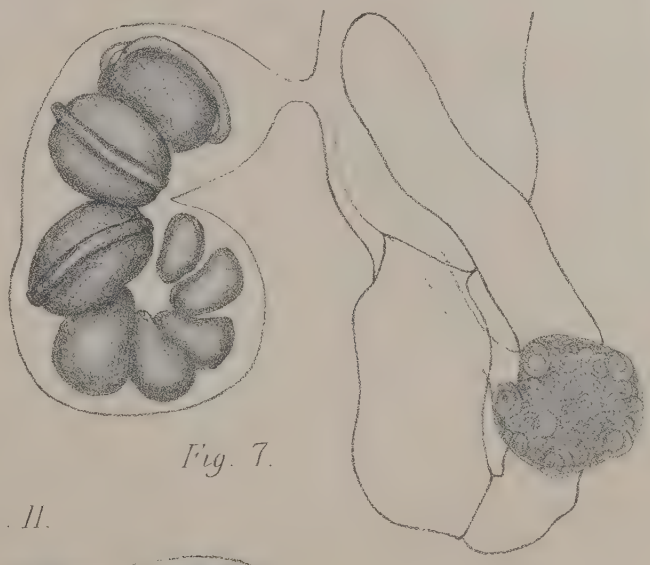

Fig. 7.

Fig. 12.

Fig. 11.

Fig. 14.

Fig. 8.

Fig. 13.

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COLELLA PEDUNCULATA, Quoy and Gaimard.

PLATE VIII.

PLATE VIII.

Colella pedunculata, Quoy and Gaimard.

bl. Bladder cell. *emb.* A bud. | *o.s.* Outer surface of the test. *t.m.* Test matrix. | *v.ap.* Vascular appendage.

Fig. 1. Part of the peduncle; slightly enlarged.

Fig. 2. Transverse sections near the lower end of the peduncle; natural size.

Fig. 3. Transverse sections from the middle of the peduncle; natural size.

Fig. 4. Transverse sections from another peduncle; natural size.

Fig. 5. Transverse sections from the upper end of the peduncle; natural size.

Fig. 6. A transverse section from the lower end of the peduncle (fig. 2), showing a young bud; magnified (S., 1 inch).

Fig. 7. A transverse section from further up the peduncle (fig. 3), showing several buds; magnified (S., 1 inch).

Fig. 8. Part of a transverse section through the upper end of a peduncle, showing a number of buds; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 9. Part of a longitudinal section through the peduncle, showing the vascular appendages and buds; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Part of a transverse section through the upper end of the peduncle, showing the vascular appendages; magnified (S., 1 inch).

Fig. 11. Part of a transverse section through the base of the head, showing the vascular appendages and their canals; magnified (S., 1 inch).

Fig. 12. Part of a transverse section of the peduncle, showing a vascular appendage imbedded in the test; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 13. The ectoderm covering a vascular appendage; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 2.

Fig. 1

Fig. 3.

Fig 4

Fig. 5.

Fig. 6.

Fig 7

Fig. 8.

Fig. 10.

Fig 12.

Fig. 9

Fig. 11

Fig 13.

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COLELLA PEDUNCULATA, Quoy and Gaimard.

PLATE IX.

PLATE IX.

Colella pedunculata, Quoy and Gaimard.

bl. Bladder cells.	*n.g.* Nerve ganglion.	*t.m.* Test matrix.
br. Branchial aperture.	*n.t.* Neural canal.	*tr.* Transverse vessel of branchial sac.
br.s. Branchial sac.	*o.* Ovary.	*v.* Vessel in test.
ec. Ectoderm.	*p.br.* Peribranchial cavity.	*v.ap.* Vascular appendage.
i. Intestine.	*sg.* Stigmata of branchial sac.	*v.ap.c.* The canal of the vascular appendage.
emb. A bud.	*st.* Stomach.	
en. Endostyle.	*t.c.* Test cells.	

Fig. 1. Transverse section through part of peduncle, showing the structure of the test and the vascular appendages; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 2. Part of a transverse section, showing the cavities of vascular appendages containing proliferating blood-corpuscles; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 3. Part of a longitudinal section, showing a young bud projecting from a vascular appendage; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Part of a transverse section, showing a young bud emerging from a vascular appendage; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Part of a longitudinal section, showing a young bud lying in the test alongside a vascular appendage; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. Part of a longitudinal section, showing a young bud just becoming separated from the vascular appendage; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 7. Transverse section of a young bud, showing the division of the archenteron; highly magnified (S., $\frac{1}{4}$ inch).

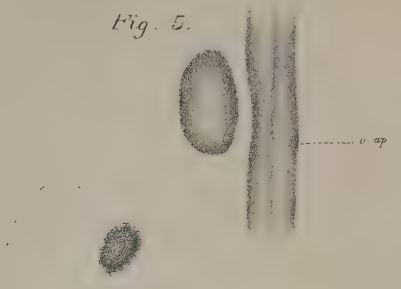
Fig. 8. Transverse section of an older bud, showing the branchial sac, peribranchial cavities, neural canal, &c.; highly magnified (S., $\frac{1}{6}$ inch).

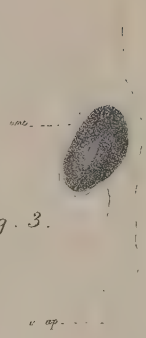
Fig. 9. Longitudinal section of an advanced bud; highly magnified (S., $\frac{1}{6}$ inch).

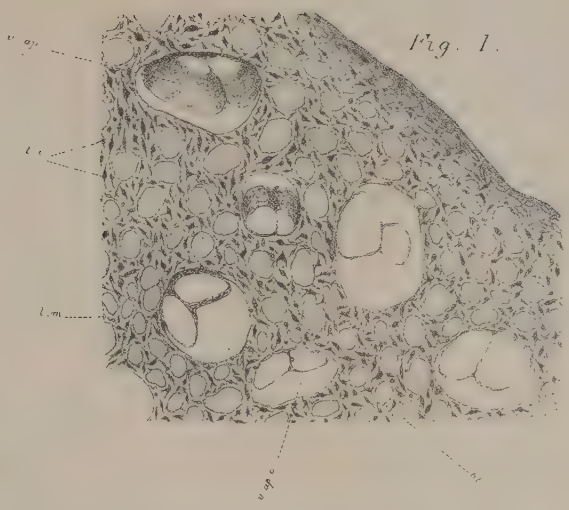
Fig. 10. Longitudinal section of a younger bud; highly magnified (S., $\frac{1}{6}$ inch).

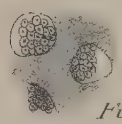
Fig. 11. Part of an advanced bud, showing the interior of the branchial sac with stigmata; highly magnified (S., $\frac{1}{4}$ inch).

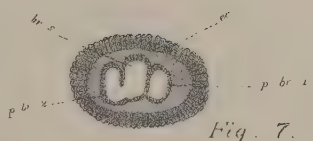
Fig. 12. Longitudinal section of a very advanced bud or young Ascidiozooid, showing all the important organs; highly magnified (S., $\frac{1}{4}$ inch).

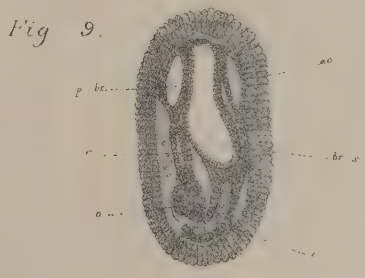












COLELLA PEDUNCULATA, Quoy and Gaimard.

PLATE X.

PLATE X.

Colella thomsoni, n. sp.

Fig. 1. Colony of *Colella thomsoni;* natural size.

Fig. 2. Upper end of colony of *Colella thomsoni;* natural size.

Fig. 3. Peduncle and lower end of head of *Colella thomsoni;* natural size.

Fig. 4. Surface view of upper end of head of *Colella thomsoni;* natural size.

Fig. 5. Transverse section through head of *Colella thomsoni;* natural size.

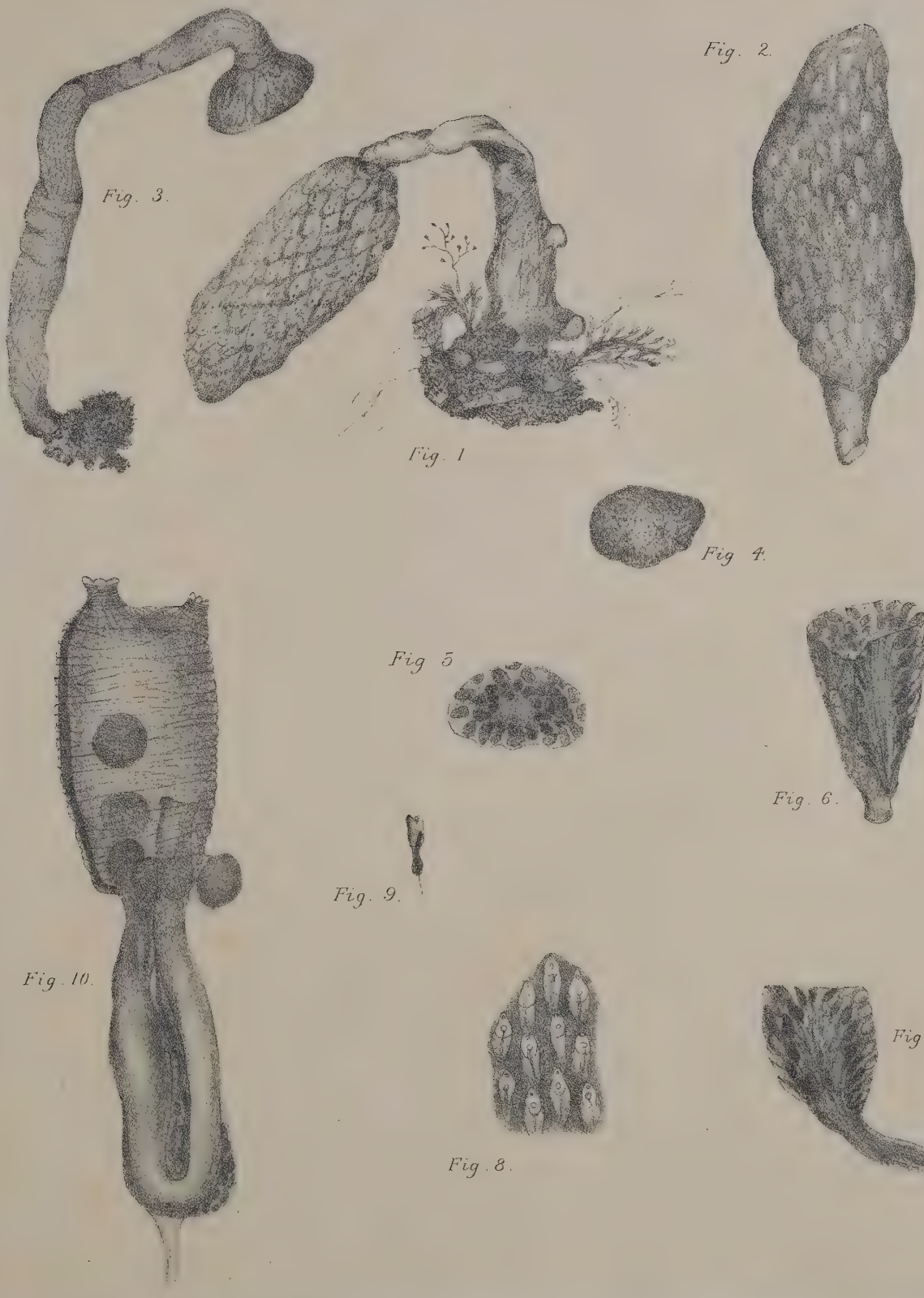
Fig. 6. Dissection of head of *Colella thomsoni*, to show arrangement of Ascidiozooids; natural size.

Fig. 7. Vertical section of lower part of head and upper part of peduncle; natural size.

Fig. 8. Part of the surface of the head; enlarged.

Fig. 9. An Ascidiozooid dissected out from the head of *Colella thomsoni;* natural size.

Fig. 10. The Ascidiozooid of *Colella thomsoni*, seen from the left hand side; magnified (S., 1 inch).



COLELLA THOMSONI. n.sp.

PLATE XI.

PLATE XI.

Colella thomsoni, n. sp.

emb. A bud.	*l.v.* Fine longitudinal vessels of branchial sac.	*r.* Rectum.
en. Endostyle.	*m.* Mantle.	*sg.* Stigmata of branchial sac.
h.m. Horizontal membrane of branchial sac.	*m.b.* Muscle band in mantle.	*t.c.* Test cells.
l. Dorsal languet.	*p.p.* Peripharyngeal band.	*t.m.* Test matrix.
		tr. Transverse vessel of branchial sac.

Fig. 1. Section through the test of *Colella thomsoni;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 2. Part of the body of the Ascidiozooid, seen from the right hand side; magnified (S., 1 inch).

Fig. 3. Part of the mantle and endostyle, showing the arrangement of the muscle bands; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Surface view of the ectoderm of *Colella thomsoni;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 5. Part of the branchial sac; highly magnified (S., $\frac{1}{4}$ inch).

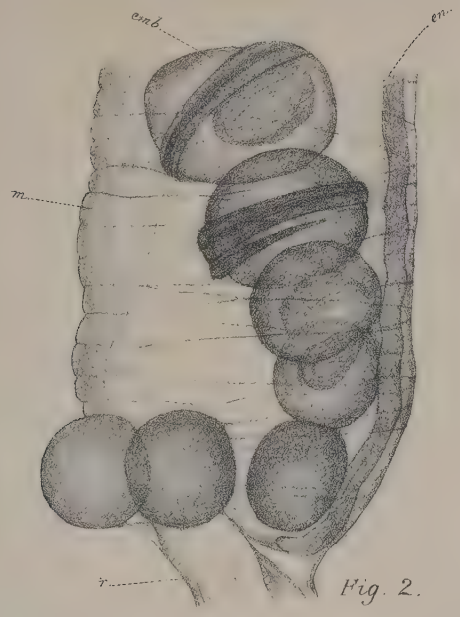
Fig. 6. A small portion of the branchial sac; more highly magnified (S., $\frac{1}{6}$ inch).

Fig. 7. Another small portion of the branchial sac; still more highly magnified (S., $\frac{1}{6}$ inch, enlarged).

Fig. 8. The anterior part of the endostyle; magnified (S., 1 inch).

Fig. 9. Part of the dorsal region of the branchial sac, showing two of the languets; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. The same region in another specimen, showing the languets; highly magnified (S., $\frac{1}{4}$ inch).



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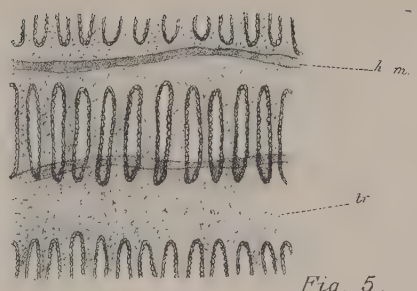

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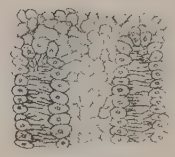

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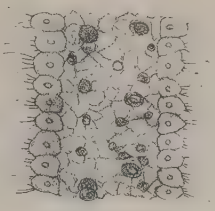

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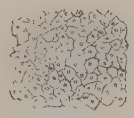
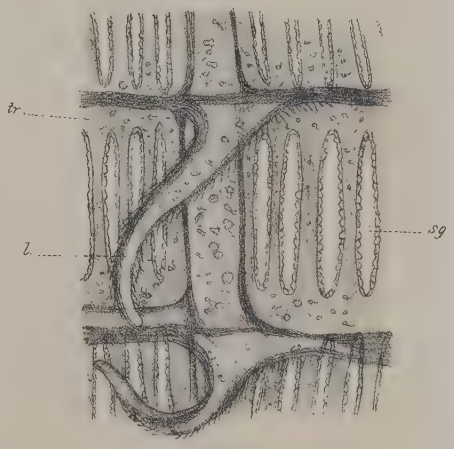


Fig. 4.

Fig. 1.

Fig. 8.



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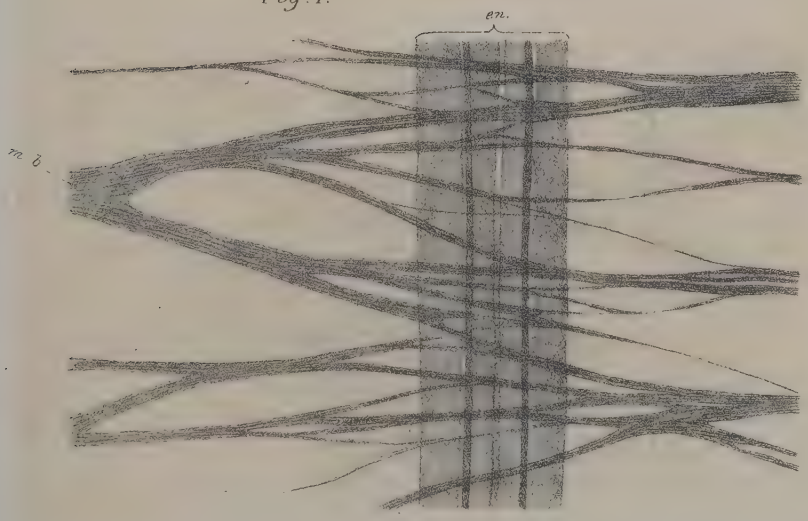

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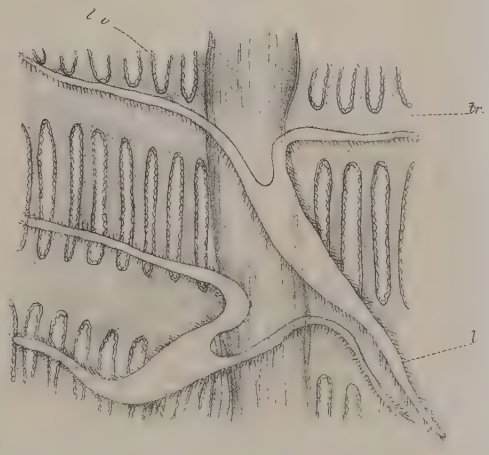

Fig. 10.

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T. Dobb & C° Lith.ˢ Lpool

COLELLA THOMSONI. n.sp.

PLATE XII.

PLATE XII.

Colella thomsoni, n. sp.

Fig. 1. The anterior end of an Ascidiozooid, seen from the interior; magnified (S., 1 inch).

Fig. 2. The anterior end of an Ascidiozooid, showing the branchial aperture, tentacles, &c., seen from the interior; magnified (S., 1 inch).

Fig. 3. The anterior end of an Ascidiozooid, seen from the exterior; magnified (S., 1 inch).

Fig. 4. The alimentary canal; magnified (S., 1 inch, enlarged).

Fig. 5. A transverse section across the abdomen of the Ascidiozooid; magnified (S., 1 inch, enlarged).

Fig. 6. The abdomen of an Ascidiozooid, showing the alimentary canal and reproductive organs; magnified (S., 1 inch, enlarged).

Fig. 7. The male reproductive system of an Ascidiozooid; magnified (S., 1 inch, enlarged).

Fig. 8. A transverse section across the abdomen of a young Ascidiozooid, showing the ovary; magnified (S., 1 inch).

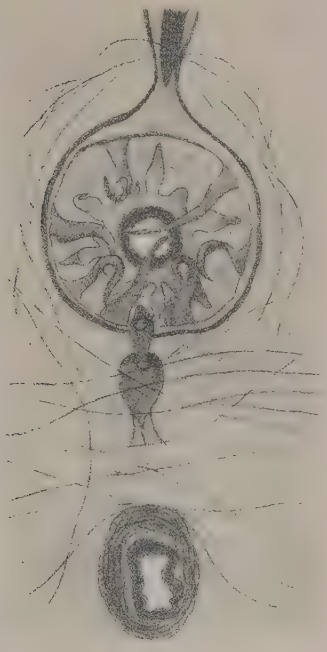
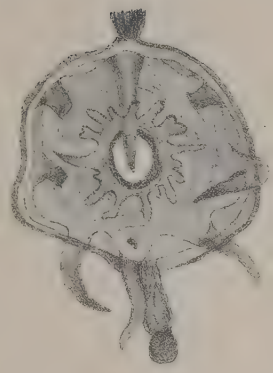


Fig 1.



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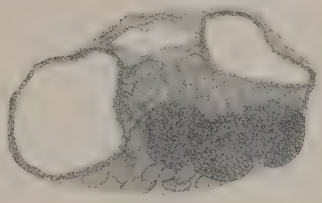

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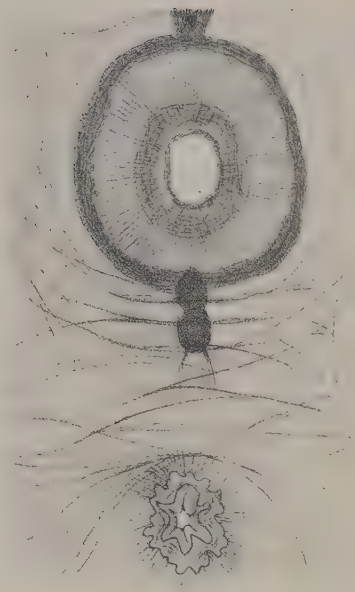


Fig. 3.

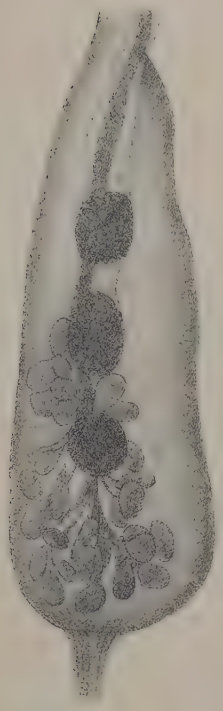


Fig. 6.

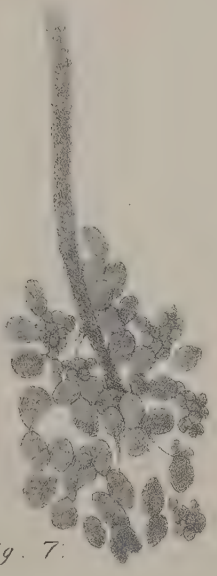


Fig. 7.

Fig. 8.

Fig. 4.

PLATE XIII.

PLATE XIII.

Colella thomsoni, n. sp.

b.c. Blood-corpuscle.	*i.* Intestine.	*r.* Rectum.
br.s. Branchial sac.	*o.* Ovary.	*st.* Stomach.
ec. Ectoderm.	*œ.* Œsophagus.	*t.* Test.
en. Endostyle.	*ov.* Ova.	*t.v.* Spermatic vesicles.
gm, gm'. Buds.	*p.br.* Peribranchial cavity.	*v.* Vessel in test.
h.gl. Glandular tubules on intestine.		

Fig. 1. Part of a transverse section through the peduncle, showing the system of ramified vessels; magnified (S., 1 inch).

Fig. 2. A small part of another section; magnified (S., 1 inch).

Fig. 3. A small part of another section; magnified (S., 1 inch).

Fig. 4. Part of another section; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Part of the wall of one of the vessels from the peduncle; more highly magnified (S., $\frac{1}{6}$ inch).

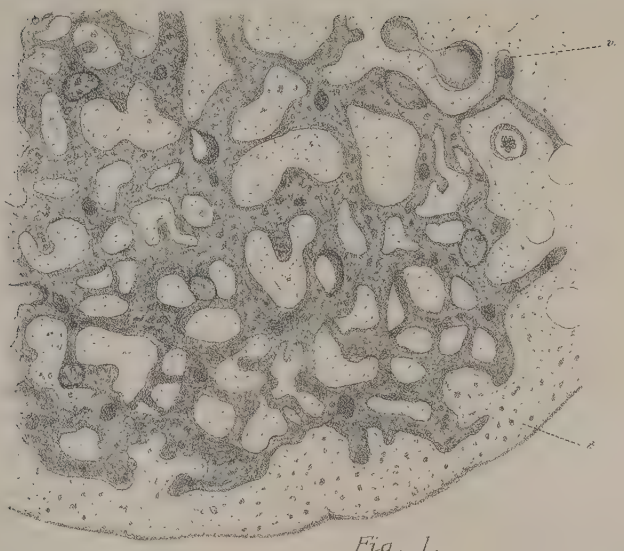
Fig. 6. Some of the ectoderm cells from a vessel; still more highly magnified (Z., $\frac{1}{12}$).

Fig. 7. Part of a section, from the upper part of the peduncle, showing young buds; magnified (S., 1 inch).

Fig. 8. Part of a section from still further up the peduncle, showing more advanced buds still connected with the vessels; magnified (S., 1 inch).

Fig. 9. The end of a diverticulum, from one of the vessels of the test, showing the commencement of the formation of a bud; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Longitudinal section of a very advanced bud or young Ascidiozooid (1 mm. in length), showing all the important organs of the body highly magnified (S., $\frac{1}{4}$ inch).



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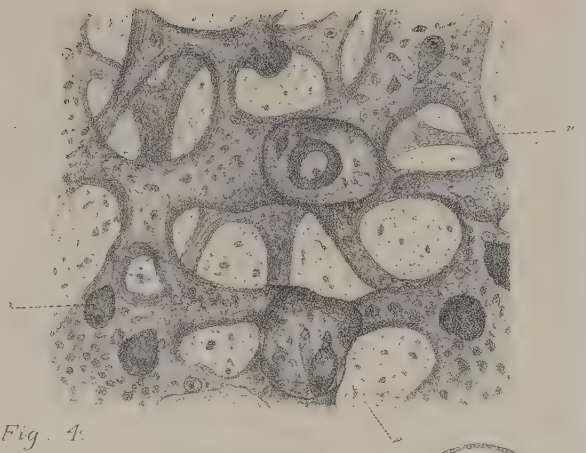


Fig. 4.

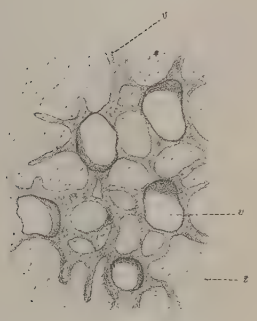


Fig. 2.

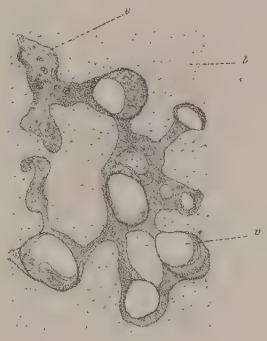


Fig. 3.

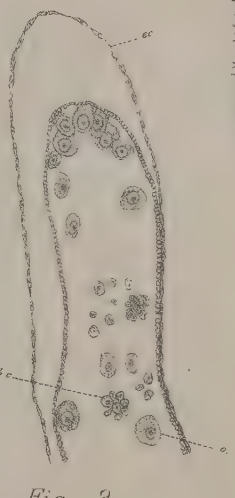
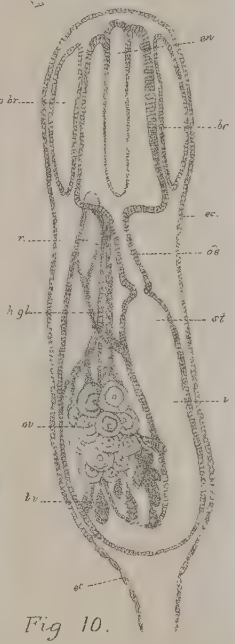


Fig. 9.

Fig. 5.

Fig. 6.



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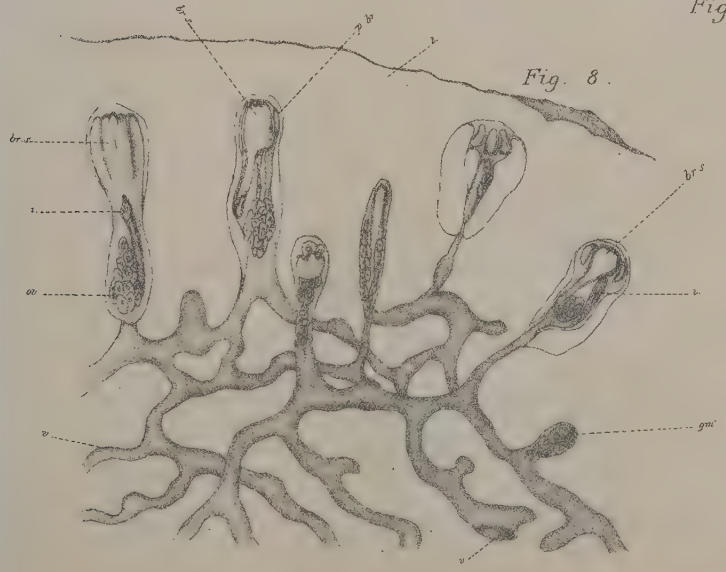

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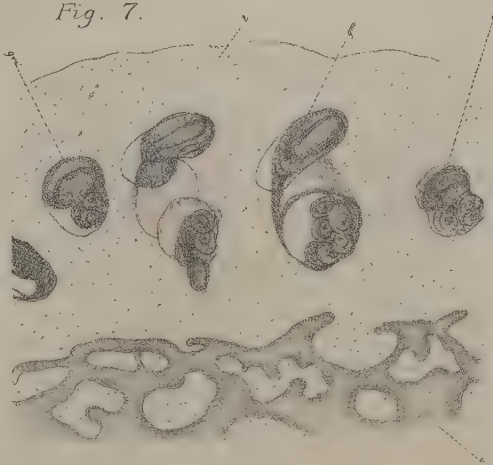

Fig. 7.

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COLELLA THOMSONI, n.sp.

PLATE XIV.

PLATE XIV.

Figs. 1–6. *Colella quoyi*, n. sp.
Figs. 7–14. *Colella gaimardi*, n. sp.
Figs. 15–23. *Polyclinum fungosum*, n. sp.

a. Anus.
at. Atrial aperture.
br. Branchial aperture.
d.l. Dorsal lamina.
d.t. Dorsal tubercle.
en. Endostyle.
g. Reproductive organs.
i. Intestine.
l. Dorsal languet.
l.v. Fine longitudinal vessels of branchial sac.
m.b. Muscle band in mantle.
n.g. Nerve ganglion.
o. Ovary.
œ. Œsophagus.
p.p. Peripharyngeal band.
r. Rectum.
sg. Stigmata of branchial sac.
st. Stomach.
t.c. Test cells.
t.m. Test matrix.
tn, tn'. Tentacles.
tr. Transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v.ap. Vascular appendage.
v.d. Vas deferens.

Fig. 1. Colony of *Colella quoyi;* natural size.

Fig. 2. Another colony of *Colella quoyi;* natural size.

Fig. 3. Part of the branchial sac of *Colella quoyi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Part of the mantle of *Colella quoyi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. The Ascidiozooid of *Colella quoyi*, seen from the left side; magnified (S., 1 inch).

Fig. 6. Part of the alimentary canal of another Ascidiozooid of *Colella quoyi;* magnified (S., 1 inch).

Fig. 7. Colony of *Colella gaimardi;* natural size.

Fig. 8. Part of the branchial sac of *Colella gaimardi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 9. Part of the test of *Colella gaimardi;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 10. The incubatory pouch of *Colella gaimardi;* magnified (S., 1 inch).

Fig. 11. Part of the dorsal region of the branchial sac of *Colella gaimardi*, showing languets; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 12. The abdomen of a young Ascidiozooid of *Colella gaimardi;* magnified (S., 1 inch).

Fig. 13. Part of the alimentary canal of *Colella gaimardi;* magnified (S., 1 inch).

Fig. 14. The tailed larva of *Colella gaimardi;* magnified (S., 1 inch).

Fig. 15. Colony of *Polyclinum fungosum*, seen from the upper surface; natural size.

Fig. 16. Colony of *Polyclinum fungosum*, seen from the side; natural size.

Fig. 17. Vertical section through part of the colony of *Polyclinum fungosum;* natural size.

Fig. 18. Part of the branchial sac of *Polyclinum fungosum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 19. The dorsal languets of *Polyclinum fungosum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 20. The dorsal edge of the anterior end of the Ascidiozooid of *Polyclinum fungosum*, showing tentacles, dorsal tubercle, nerve ganglion, &c.; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 21. The alimentary canal of *Polyclinum fungosum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 22. The reproductive organs of *Polyclinum fungosum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 23. Tailed larva of *Polyclinum fungosum*, seen from the side; magnified (S., 1 inch).

W A. Herdman del. F. Huth, Lith^r Edin^r

FIGS 1-6, COLELLA QUOYI, n. sp. FIGS 7-14, COLELLA GAIMARDI, n. sp.
FIGS 15-23, POLYCLINUM FUNGOSUM, n. sp.

PLATE XV.

PLATE XV.

Figs. 1–13. *Colella pulchra*, n. sp.
Figs. 14–17. *Colella ramulosa*, n. sp.

a. Anus.
ap. Appendage from the abdomen of the Ascidiozooid.
ap. Atrial aperture.
bl. Bladder cell.
br. Branchial aperture.
br.si. Branchial siphon.
c.m. Mass of cells of a nervous nature(?)
d.l. Dorsal lamina.
em. Bud.
en. Endostyle.
h.m. Horizontal membrane of branchial sac.
i. Intestine.
l. Dorsal languet.
l.v. Fine longitudinal vessels of branchial sac.
œ. Œsophagus.
ot. Pigmented sense organ.
ov. Ovary.
p.c. Pigment cells.
r. Rectum.
sg. Stigmata of branchial sac.
st. Stomach.
t. Test.
t.c. Test cells.
t.m. Test matrix.
tr. Transverse vessels of branchial sac.
t.v. Spermatic vesicles.
u. Urochord.
v.ap. Vascular appendage.
v.d. Vas deferens.

Fig. 1. Colony of *Colella pulchra*; natural size.

Fig. 2. Young colony of *Colella pulchra*; natural size.

Fig. 3. Part of branchial sac of *Colella pulchra*; magnified (S., 1 inch).

Fig. 4. Ciliated cells from stigmata of *Colella pulchra*; highly magnified (Z., $\frac{1}{12}$).

Fig. 5. Part of branchial sac and dorsal lamina of young Ascidiozooid of *Colella pulchra*; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 6. Part of the surface of the colony of *Colella pulchra*, showing arrangement of Ascidiozooids; magnified (S., 1 inch).

Fig. 7. Ascidiozooid of *Colella pulchra*, seen from left side; magnified (S., 1 inch).

Fig. 8. Pigmented appendage from region over stomach of Ascidiozooid of *Colella pulchra*; highly magnified (Z., $\frac{1}{12}$).

Fig. 9. Part of peduncle of *Colella pulchra*; magnified (S., 1 inch).

Fig. 10. Transverse section of peduncle of *Colella pulchra*; magnified (S., 1 inch).

Fig. 11. Part of a transverse section through the peduncle of *Colella pulchra*; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 12. Tailed larva of *Colella pulchra*; magnified (S., 1 inch, enlarged).

Fig. 13. Part of tailed larva of *Colella pulchra*; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 14. Colony of *Colella ramulosa*; natural size.

Fig. 15. Branched peduncle of another colony of *Colella ramulosa*; natural size.

Fig. 16. Part of the branchial sac of *Colella ramulosa*; magnified (S., 1 inch).

Fig. 17. The Ascidiozooid of *Colella ramulosa*, seen from the left hand side; magnified (S., 1 inch).

Fig. 1.

Fig. 2.

Fig. 3.

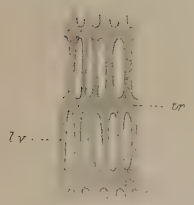
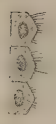


Fig. 4.



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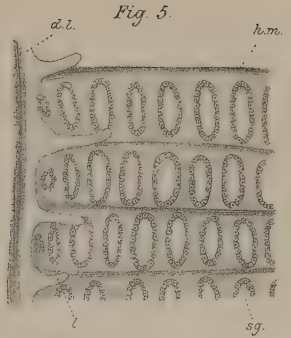


Fig. 6.

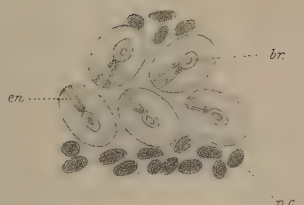


Fig. 7.

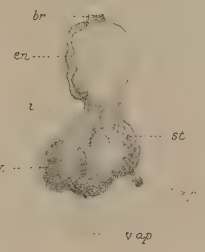
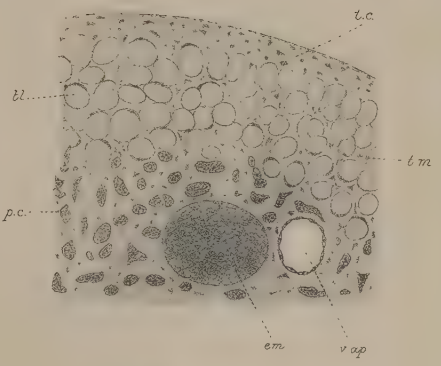


Fig. 9.

Fig. 11.



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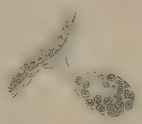

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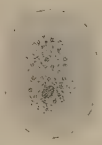
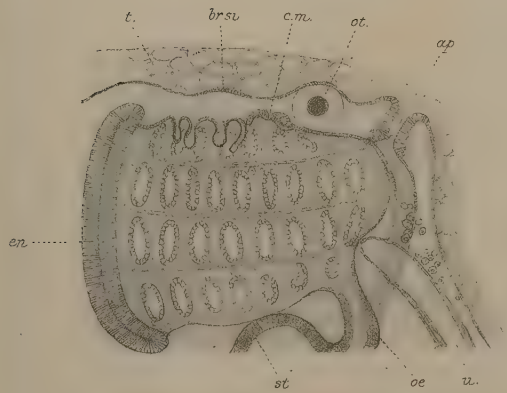


Fig. 12.

Fig. 15.

Fig. 14.

Fig. 13.



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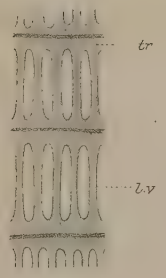
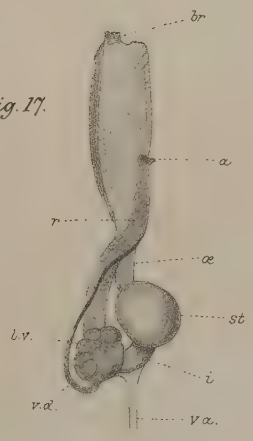


Fig. 17.



FIGS 1-13, COLELLA PULCHRA, n. sp. FIGS 14-17, COLELLA RAMULOSA, n. sp.

PLATE XVI.

PLATE XVI.

Figs. 1–7. *Colella elongata*, n. sp.
Figs. 8–16. *Colella concreta*, n. sp.
Fig. 17. ——— (?) *pyriformis*, n. sp.

abd. Abdomen of Ascidiozooid.
at. Atrial aperture.
br. Branchial aperture.
d.l. Dorsal lamina.
d.t. Dorsal tubercle.
en. Endostyle.
fd. Fold in wall of stomach.
gr. Groove between folds.
h.m. Horizontal membrane of branchial sac.
i. Intestine.
l. Dorsal languet.
ov. Ova.
p.p. Peripharyngeal band.
r. Rectum.
sph. Sphincter.
st. Stomach.
t. Test.
th. Thorax of Ascidiozooid.
tn, tn'. Tentacles.
t.v. Spermatic vesicles.
v.ap. Vascular appendage.
v.d. Vas deferens.

Fig. 1. Colony of *Colella elongata;* natural size.

Fig. 2. Transverse section of colony of *Colella elongata;* natural size.

Fig. 3. Part of a transverse section of *Colella elongata;* magnified (S., 1 inch).

Fig. 4. Part of the test from the centre of the head of *Colella elongata,* showing the vascular appendages; magnified (S., 1 inch).

Fig. 5. An Ascidiozooid of *Colella elongata,* seen from the right hand side; magnified (S., 1 inch).

Fig. 6. Part of a young Ascidiozooid of *Colella elongata,* showing the alimentary canal; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 7. Part of the circle of tentacles of *Colella elongata;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 8. Large colony of *Colella concreta;* natural size.

Fig. 9. Ascidiozooid of *Colella concreta,* seen from left hand side; enlarged.

Fig. 10. Part of the vascular appendage of *Colella elongata;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 11. Ascidiozooid of *Colella concreta,* from left hand side; magnified (S., 1 inch).

Fig. 12. Part of mantle of *Colella concreta;* magnified (S., 1 inch, enlarged).

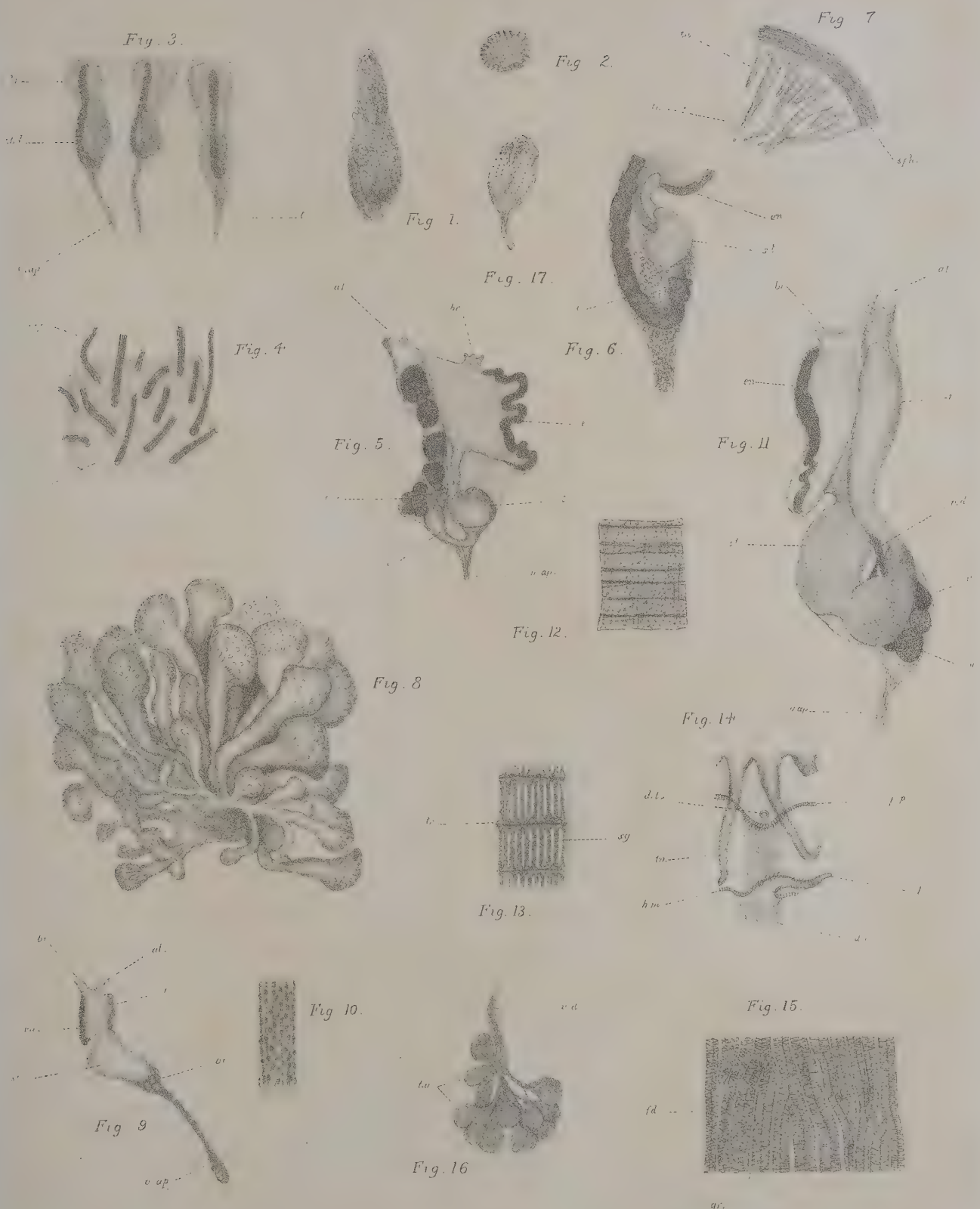
Fig. 13. Part of branchial sac of *Colella concreta;* magnified (S., 1 inch, enlarged).

Fig. 14. Dorsal part of anterior end of Ascidiozooid of *Colella concreta,* showing tentacles, dorsal tubercle, languets, &c.; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 15. Part of wall of stomach of *Colella concreta,* spread out and seen from inside to show the closely placed longitudinal folds; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 16. The male reproductive organs of *Colella concreta;* magnified (S., 1 inch).

Fig. 17. Colony of ——— (?) *pyriformis;* natural size.



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FIGS. 1-7, COLELLA ELONGATA, n. sp.
FIGS. 8-16, COLELLA CONCRETA, n. sp.
FIG. 17, ———— ? PYRIFORMIS, n. sp.

PLATE XVII.

PLATE XVII.

Figs. 1–11. *Colella murrayi*, n. sp.
Figs. 12–14. *Colella murrayi*, var. *rubida*, nov.

at. Atrial aperture.
bl. Bladder cell.
br. Branchial aperture.
en. Endostyle.
g. Reproductive organs.
i. Intestine.
l.v. Fine longitudinal vessels of branchial sac.
m. Mantle.
œ. Œsophagus.
p.c. Mass of pigment cells.
r. Rectum.
sg.c. Ciliated cells bounding stigmata of branchial sac.
st. Stomach.
t.c. Test cells.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
tn, tn'. Tentacles.
t.v. Spermatic vesicles.
v.ap. Vascular appendage.
v.d. Vas deferens.

Fig. 1. Colony of *Colella murrayi;* natural size.

Fig. 2. Upper end of colony of *Colella murrayi;* slightly enlarged.

Fig. 3. Part of branchial sac of *Colella murrayi;* magnified (S., 1 inch).

Fig. 4. Part of surface of *Colella murrayi*, to show arrangement of pigment masses; magnified (S., 1 inch).

Fig. 5. Part of transverse section of peduncle of *Colella murrayi;* magnified (S., 1 inch).

Fig. 6. The outer part of a transverse section through the peduncle of *Colella murrayi;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 7. The central part of a transverse section of the peduncle of *Colella murrayi;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 8. Part of transverse section of outer part of head of *Colella murrayi*, showing arrangement of Ascidiozooids and pigment masses; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 9. Ascidiozooid of *Colella murrayi*, seen from left side; magnified (S., 1 inch).

Fig. 10. Transverse section of abdomen of Ascidiozooid of *Colella murrayi;* magnified (S., 1 inch).

Fig. 11. Part of male reproductive organs of *Colella murrayi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 12. Colony of *Colella murrayi*, var. *rubida;* natural size.

Fig. 13. Part of circle of tentacles of *Colella murrayi*, var. *rubida;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 14. Part of branchial sac of *Colella murrayi*, var. *rubida;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 1.

Fig. 2.

Fig. 3.

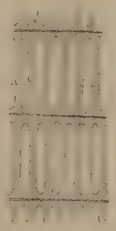


Fig. 4.

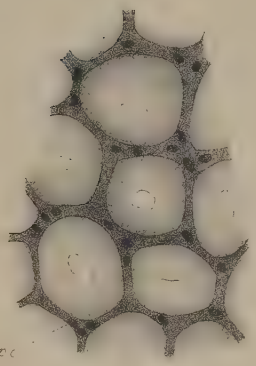


Fig. 9.

Fig. 6.

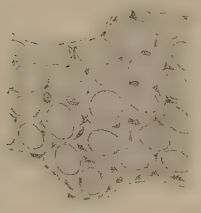
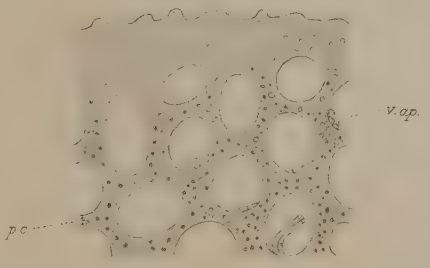


Fig. 5



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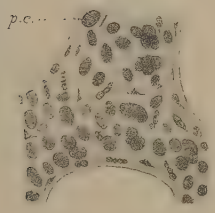


Fig. 10.

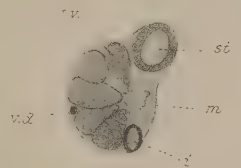


Fig. 11.

Fig. 8.

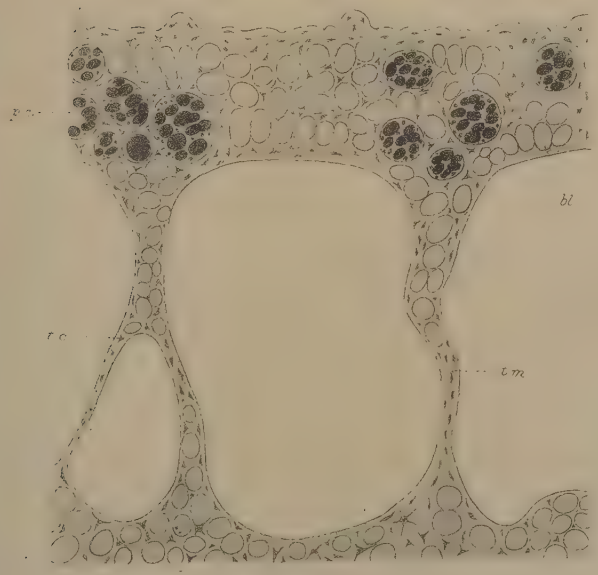
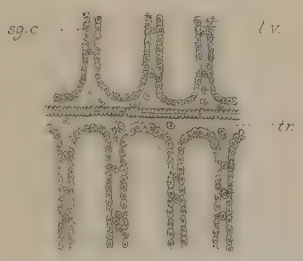


Fig. 12.

Fig. 13.

Fig. 14.



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FIGS 1-11, COLELLA MURRAYI, n. sp. FIGS 12-14, COLELLA MURRAYI, var. RUBIDA, nov.

PLATE XVIII.

PLATE XVIII.

Figs. 1–6. *Distaplia vallii*, n. sp.
Figs. 7–14. *Symplegma viride*, n. sp.

at. Atrial aperture.
br. Branchial aperture.
b.p.c. Black pigment cell.
cæ. Cæcum.
d.l. Dorsal lamina.
d.t. Dorsal tubercle.
en. Endostyle.
i. Intestine.
i.l. Internal longitudinal bar of branchial sac.
l.v. Fine longitudinal vessels of branchial sac.
m. Mantle.
œ. Œsophagus.
p.c. Mass of pigment cells.
p.p. Peripharyngeal band.
r. Rectum.
r.p.c. Red pigment cell
sg. Stigmata of branchial sac.
sph. Sphincter.
st. Stomach.
t.c. Test cells.
t.k. Terminal bulb on vessel in test.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
v. Vessel in test.
v.ap. Vascular appendage.
z. Prebranchial zone.

Fig. 1. Colony of *Distaplia vallii*, from Station 212; natural size.

Fig. 2. Colony of *Distaplia vallii*, from Mediterranean; natural size.

Fig. 3. Ascidiozooid of *Distaplia rosea*, from Naples; magnified (S., 1 inch).

Fig. 4. Section through test of *Distaplia vallii;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 5. Part of mantle of *Distaplia vallii*, from Mediterranean, showing pigmentation; magnified (S., 1 inch).

Fig. 6. Part of branchial sac of *Distaplia vallii;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 7. Colony of *Symplegma viride;* natural size.

Fig. 8. Part of test of *Symplegma viride*, showing vessels; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 9. Part of outer layer of test of *Symplegma viride*, showing network of vessels; magnified (S., 1 inch).

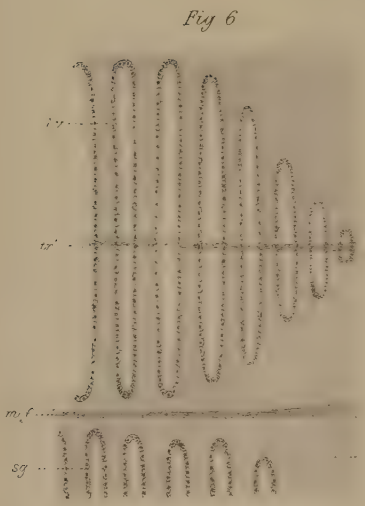
Fig. 10. Part of branchial sac of *Symplegma viride;* magnified (S., 1 inch).

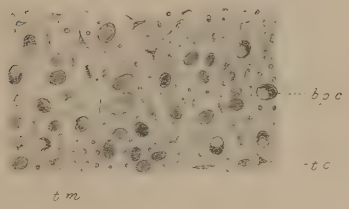
Fig. 11. Small part of another branchial sac of *Symplegma viride;* magnified (S., 1 inch).

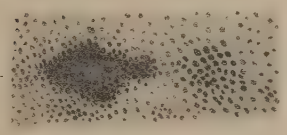
Fig. 12. Part of branchial sac of young Ascidiozooid of *Symplegma viride*, showing internal longitudinal bars; highly magnified (S., $\frac{1}{4}$ inch).

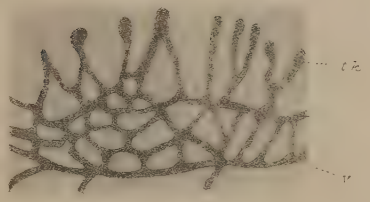
Fig. 13. Dorsal part of anterior end of Ascidiozooid of *Symplegma viride*, showing dorsal lamina, &c.; tentacles not represented; highly magnified (S., $\frac{1}{6}$ inch).

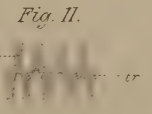
Fig. 14. Alimentary canal of *Symplegma viride;* magnified (S., 1 inch).

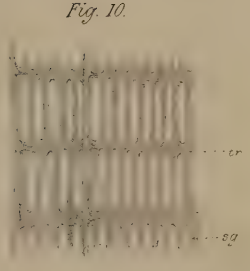


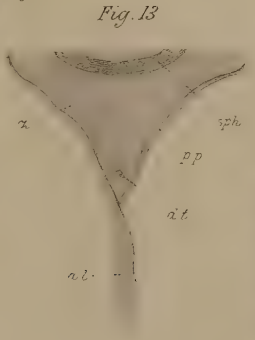


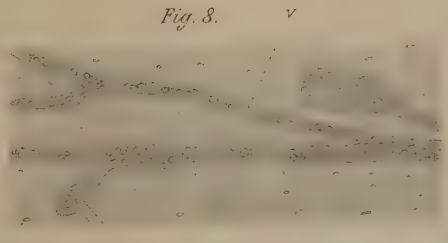


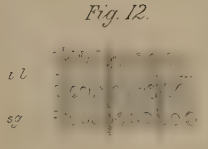












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FIGS 1-6, DISTAPLIA VALLII, n. sp. FIGS 7-14, SYMPLEGMA VIRIDE, n sp

PLATE XIX.

PLATE XIX.

Cystodytes draschii, n. sp.

ad.p. Adhering papilla.
at. Atrial aperture.
at.si. Atrial siphon.
bl. Bladder cell.
br. Branchial aperture.
br.s. Branchial sac.
br.si. Branchial siphon.
cap. Calcareous capsule around Ascidiozooid.
en. Endostyle.
l.s. Lower surface of colony.
m. Mantle.
m.b. Muscle band in mantle.
mar. Free margin of colony.
n.g. Nerve ganglion.
s.o. Sense organ.
sp. Calcareous spicule in test.
sph. Sphincter.
t.c. Test cells.
t.c'. Modified test cells.
th. Thorax.
t.m. Test matrix.
tn, tn'. Tentacles.
u.s. Upper surface of colony.

Fig. 1. Colony of *Cystodytes draschii;* natural size.

Fig. 2. Part of section through test of *Cystodytes draschii;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 3. Part of section through colony of *Cystodytes draschii*, showing relation of Ascidiozooid to test and calcareous spicules; magnified (S., 1 inch).

Fig. 4. Part of vertical section through colony of *Cystodytes draschii*, showing free margin, &c.; slightly enlarged.

Fig. 5. Ascidiozooid of *Cystodytes draschii;* natural size.

Fig. 6. Two calcareous spicules from the test of *Cystodytes draschii;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 7. Part of calcareous capsule showing overlapping spicules; magnified (S., 1 inch).

Fig. 8. Connective-tissue cells from mantle of *Cystodytes draschii;* highly magnified (Z., $\frac{1}{12}$).

Fig. 9. Part of mantle of *Cystodytes draschii;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Branchial siphon, &c., of *Cystodytes draschii;* highly magnified (Z., $\frac{1}{12}$).

Fig. 11. Anterior end of Ascidiozooid of *Cystodytes draschii;* magnified (S., 1 inch).

Fig. 12. Tentacles of *Cystodytes draschii;* magnified (S., $\frac{1}{4}$ inch, reduced).

Fig. 13. Part of a tentacle of *Cystodytes draschii;* highly magnified (Z., $\frac{1}{12}$).

Fig. 14. Tip of a tentacle of *Cystodytes draschii;* highly magnified (Z., $\frac{1}{12}$).

Fig. 15. Tailed larva of *Cystodytes draschii;* magnified (S., 1 inch).

Fig. 1.

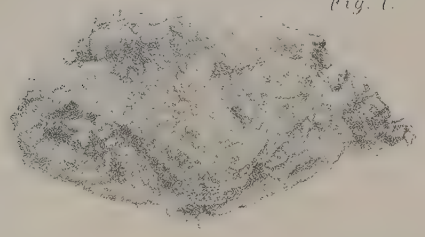


Fig. 2

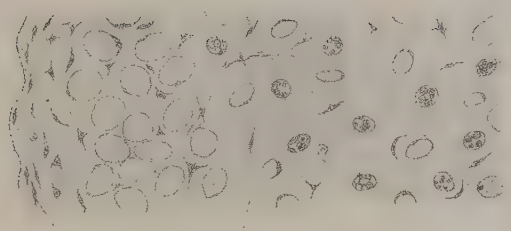


Fig. 3.

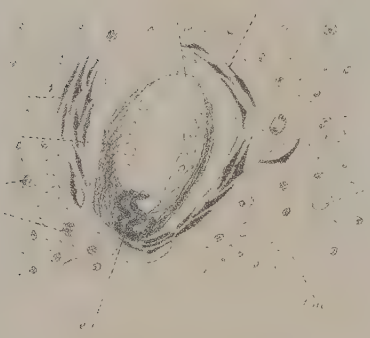


Fig. 5.

Fig. 6.

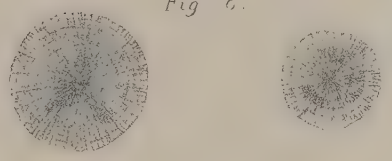


Fig. 4.

Fig. 7.

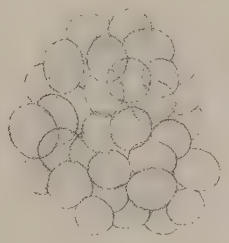


Fig. 8

Fig. 9.

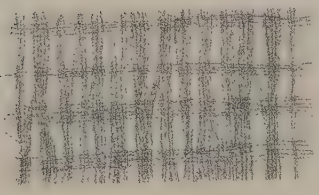
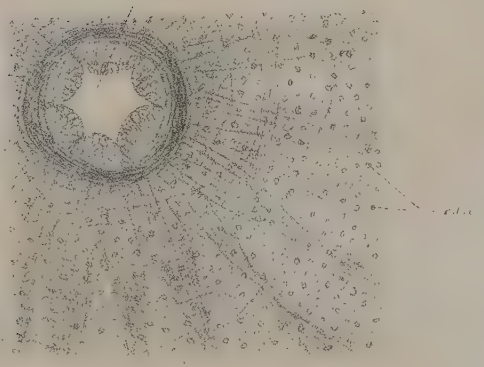


Fig. 11.

Fig. 15.

Fig. 12.

Fig. 10.



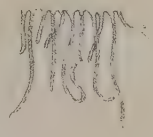


Fig. 13.

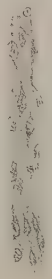


Fig 14.

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CYSTODYTES DRASCHII. n. sp

PLATE XX.

PLATE XX.

Cystodytes philippinensis, n. sp.

ab. Abdomen of Ascidiozooid.
at. Atrial aperture.
br. Branchial aperture.
bl. Bladder cell.
br.si. Branchial siphon.
cap. Calcareous capsule around Ascidiozooid.
l.s. Lower surface of colony.
m. Mantle.
mar. Free margin of colony.
sg. Stigmata of branchial sac.
sp. Calcareous spicule in test.
t. Test.
t.c. Test cells.
t.c'. Modified test cells.
th. Thorax of Ascidiozooid.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
u.s. Upper surface of colony.

Fig. 1. Colony of *Cystodytes philippinensis;* natural size.

Fig. 2. Another colony of *Cystodytes philippinensis;* natural size.

Fig. 3. Vertical section of part of colony of *Cystodytes philippinensis*; slightly enlarged.

Fig. 4. Calcareous spicules from test of *Cystodytes philippinensis;* A, from side, B, from edge; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Part of section of colony of *Cystodytes philippinensis*, showing relation of Ascidiozooid to test and spicules; magnified (S., 1 inch).

Fig. 6. Section of test of *Cystodytes philippinensis;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 7. Anterior part of Ascidiozooid of *Cystodytes philippinensis*; magnified (S., 1 inch).

Fig. 8. Part of branchial sac of *Cystodytes philippinensis;* magnified (S., 1 inch).

Fig. 9. Part of test from lower surface of colony of *Cystodytes philippinensis;* magnified (S., 1 inch).

Fig. 10. Surface layer of test of *Cystodytes philippinensis*, seen from interior, showing branchial apertures; magnified (S., 1 inch).

Fig. 11. Diagrammatic vertical section of colony of *Cystodytes philippinensis*, showing arrangement of Ascidiozooids and their relation to calcareous capsule; magnified.

Fig. 12. Part of vertical section of upper surface of colony of *Cystodytes philippinensis*, showing structure of test; magnified (S., 1 inch).

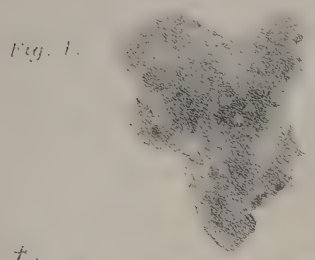

Fig. 1.

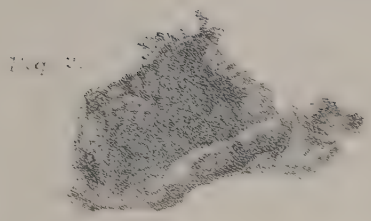

Fig. 2.

Fig. 7.

Fig. 4.

Fig. 3.

Fig. 8.

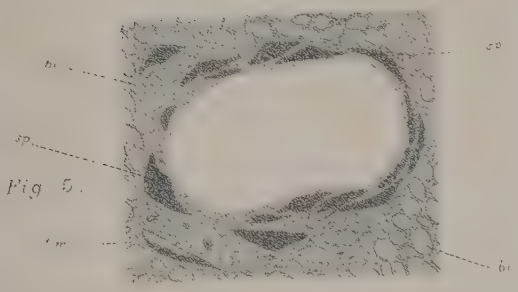

Fig. 5.

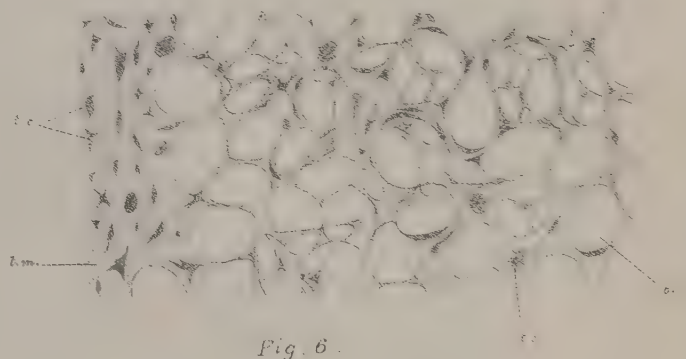

Fig. 6.

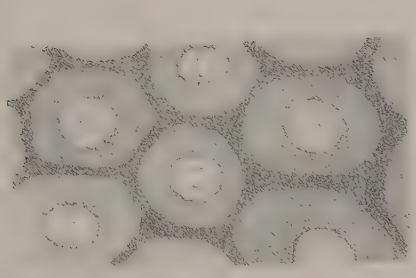

Fig. 10.

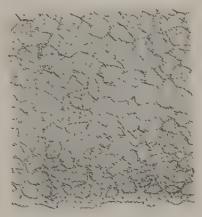

Fig. 9.

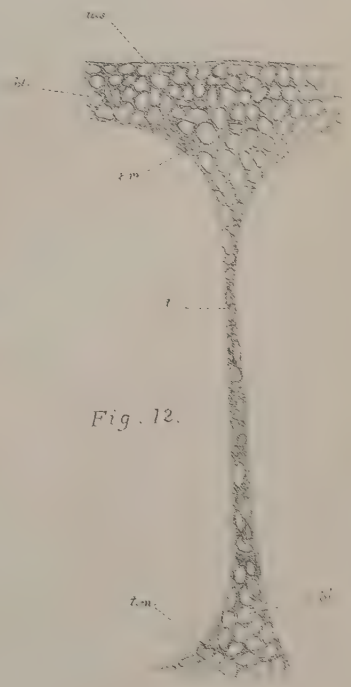

Fig. 12.

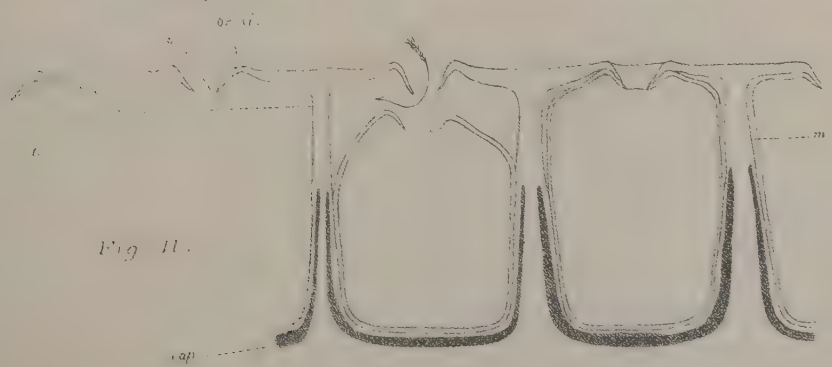

Fig. 11.

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CYSTODYTES PHILIPPINENSIS, n. sp.

PLATE XXI.

PLATE XXI.

Pharyngodictyon mirabile, n. sp.

i.l. Internal longitudinal bar of branchial sac.	*tr.* Transverse vessel of branchial sac.	*t.v.* Spermatic vesicles.
m.f. Muscle fibres.	*t.c.* Test cells.	*v.d.* Vas deferens.
	t.m. Test matrix.	

Fig. 1. Colony of *Pharyngodictyon mirabile;* natural size.

Fig. 2. Another colony of *Pharyngodictyon mirabile;* natural size.

Fig. 3. Two colonies of *Pharyngodictyon mirabile;* natural size.

Fig. 4. Ascidiozooid of *Pharyngodictyon mirabile;* slightly enlarged.

Fig. 5. Ascidiozooid of *Pharyngodictyon mirabile*, seen from left side; magnified (S., 1 inch).

Fig. 6. Section through test of *Pharyngodictyon mirabile;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 7. Section through part of colony of *Pharyngodictyon mirabile*, to show arrangement of Ascidiozooids; magnified (S., 1 inch).

Fig. 8. Part of mantle of *Pharyngodictyon mirabile*, showing muscle bands; magnified (S., 1 inch).

Fig. 9. Muscle band, from mantle; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 10. Muscle fibre, from mantle; more highly magnified (Z., $\frac{1}{12}$).

Fig. 11. Another muscle fibre, from mantle; highly magnified (Z., $\frac{1}{12}$).

Fig. 12. Part of branchial sac of *Pharyngodictyon mirabile;* magnified (S., 1 inch).

Fig. 13. Edge of a vessel, from branchial sac; highly magnified (S., $\frac{1}{6}$ inch).

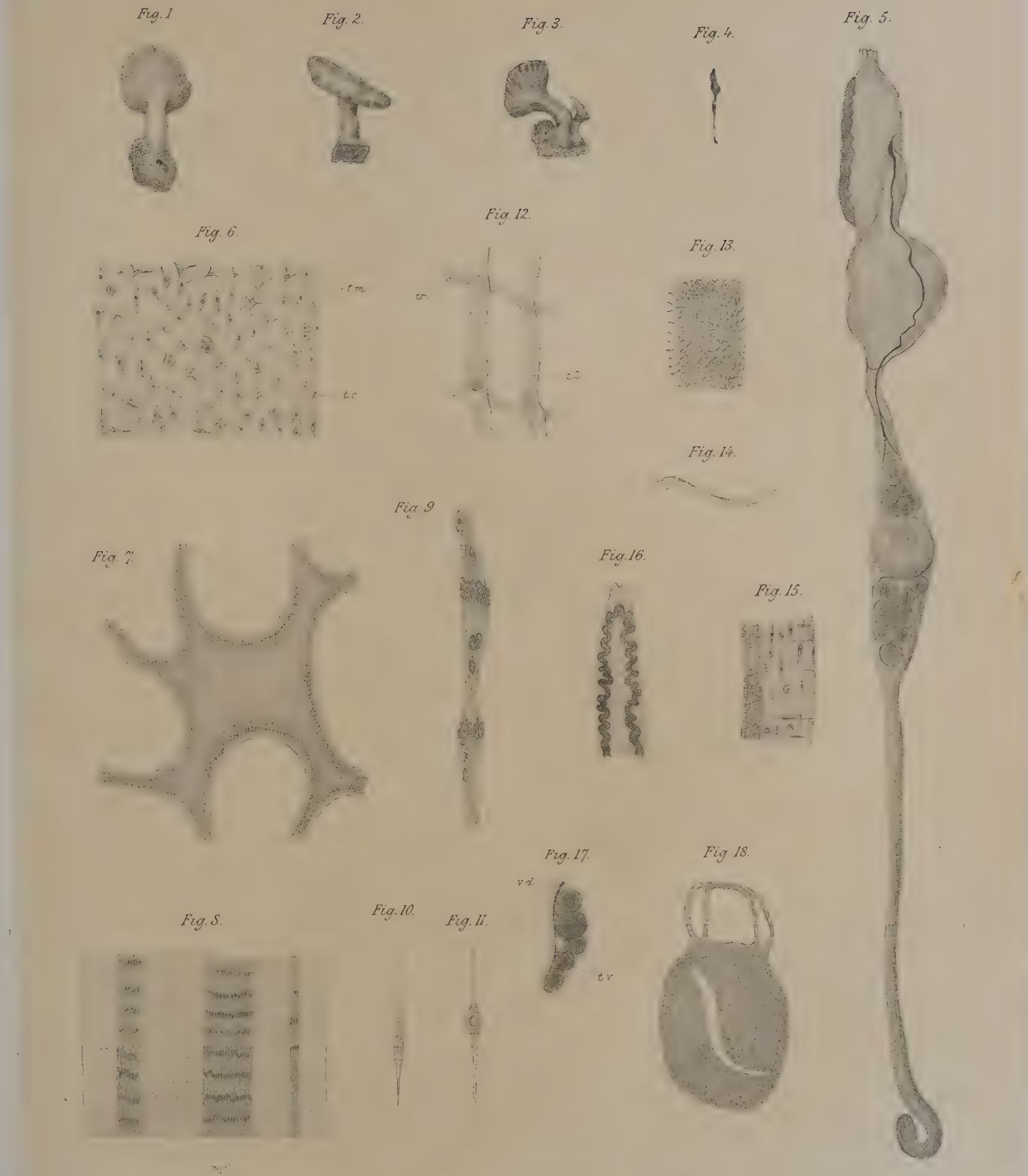
Fig. 14. Tentacle of *Pharyngodictyon mirabile*, seen from side; magnified (S., 1 inch).

Fig. 15. Small part of tentacle of *Pharyngodictyon mirabile*, seen from side; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 16. Anterior extremity of endostyle of *Pharyngodictyon mirabile;* magnified (S., 1 inch).

Fig. 17. Part of male reproductive organs of *Pharyngodictyon mirabile;* magnified (S., 1 inch).

Fig. 18. Oblique section through post-abdomen of Ascidiozooid of *Pharyngodictyon mirabile;* magnified (S., 1 inch).



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PHARYNGODICTYON MIRABILE, n. sp.

PLATE XXII.

PLATE XXII.

Tylobranchion speciosum, n. sp.

b.s. Blood sinus.
d.t. Dorsal tubercle.
d.l. Dorsal lamina.
ec. Ectoderm.
g.t. Germinal tubule.
h.m. Horizontal membrane of branchial sac.
l. Languet.
m.b. Muscle band in mantle.
o. Ovum.
p. Papilla.
p.p. Peripharyngeal band.
sg. Stigmata of branchial sac.
sph. Sphincter.
t.c. Test cells.
t.m. Test matrix.
tn. Tentacles.
tr. Transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v.d. Vas deferens.

Fig. 1. Colony of *Tylobranchion speciosum*; natural size.

Fig. 2. Ascidiozooid of *Tylobranchion speciosum*; natural size.

Fig. 3. Another Ascidiozooid with much larger post-abdomen; natural size.

Fig. 4. Ascidiozooid, seen from right hand side; magnified (S., 1 inch).

Fig. 5. Part of test of *Tylobranchion speciosum*; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 6. Part of endostyle of *Tylobranchion speciosum*, seen from ventral surface; magnified (S., 1 inch).

Fig. 7. Part of branchial sac of *Tylobranchion speciosum*, seen from the interior; magnified (S., 1 inch).

Fig. 8. Part of another branchial sac, from interior; magnified (S., 1 inch).

Fig. 9. Another part of the branchial sac, from interior; magnified (S., 1 inch).

Fig. 10. Small part of branchial sac; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 11. Three ciliated cells, from stigmata; highly magnified (S., $\frac{1}{6}$ inch, enlarged).

Fig. 12. Part of dorsal edge of branchial sac, showing languets; magnified (S., 1 inch).

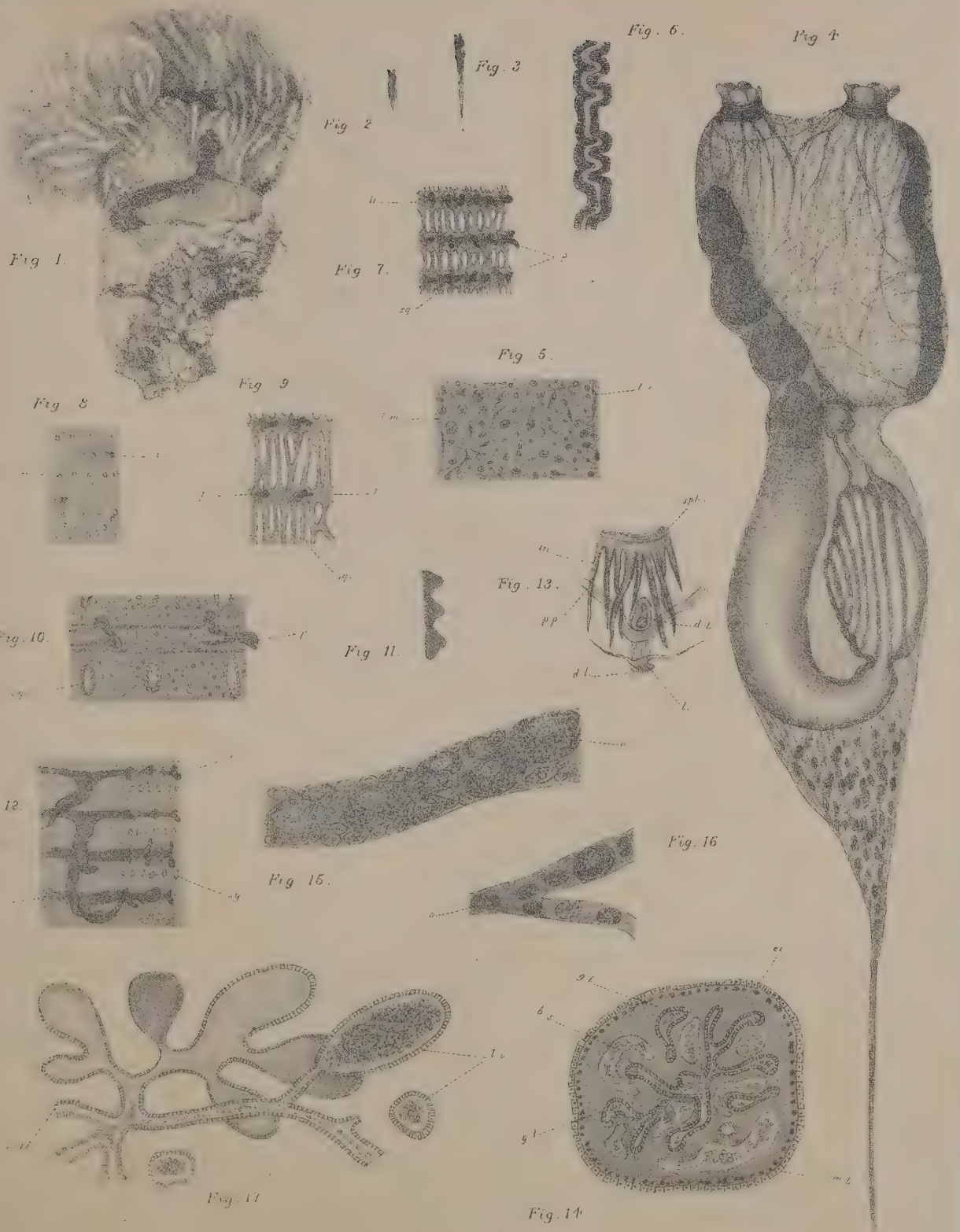
Fig. 13. Dorsal part of anterior end of Ascidiozooid, showing tentacles, &c.; magnified (S., 1 inch).

Fig. 14. Diagrammatic transverse section of post-abdomen, showing tubules in which the reproductive elements are produced; magnified.

Fig. 15. Part of germinal tubule, from young Ascidiozooid, showing ova in various stages of development; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 16. Part of smaller tubules, containing young ova; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 17. Tubules from older Ascidiozooid, in which spermatozoa are being produced; highly magnified (S., $\frac{1}{6}$ inch).



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TYLOBRANCHION SPECIOSUM, n. sp.

PLATE XXIII.

PLATE XXIII.

Figs. 1–6. *Atopogaster gigantea*, n. sp.
Figs. 7–13. *Atopogaster aurantiaca*, n. sp.

bl. Bladder cell.
br. Branchial aperture.
ep. Band of thickened epithelium connecting languets on dorsal lamina.
h.m. Horizontal membrane of branchial sac.
i. Intestine.
l. Dorsal languet.
m.f. Muscle fibres.
œ. Œsophagus.
p.ab. Post-abdomen.
p.c. Mass of pigment cells.
r. Rectum.
sg. Stigmata of branchial sac.
st. Stomach.
t.c. Test cells.
t.k. Terminal bulb on vessel in test.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
v. Vessel in test.

Fig. 1. Colony of *Atopogaster gigantea;* one half natural size.

Fig. 2. Part of surface of *Atopogaster gigantea*, showing systems; slightly enlarged.

Fig. 3. Ascidiozooid of *Atopogaster gigantea*, from left side; magnified (S., 1 inch).

Fig. 4. Part of branchial sac of *Atopogaster gigantea;* magnified (S., 1 inch).

Fig. 5. Branchial siphon and lobes of *Atopogaster gigantea;* magnified (S., 1 inch).

Fig. 6. Larva of *Atopogaster gigantea;* magnified (S., 1 inch).

Fig. 7. Colony of *Atopogaster aurantiaca;* natural size.

Fig. 8. Branchial siphon and lobes of *Atopogaster aurantiaca;* magnified (S., 1 inch).

Fig. 9. Section of test of *Atopogaster aurantiaca;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Part of branchial sac of *Atopogaster aurantiaca;* magnified (S., 1 inch).

Fig. 11. Part of dorsal lamina of *Atopogaster aurantiaca*, from the side, showing languets; magnified (S., 1 inch).

Fig. 12. Part of dorsal lamina of *Atopogaster aurantiaca*, from the front, showing languets, &c.; magnified (S., 1 inch).

Fig. 13. Larva of *Atopogaster aurantiaca;* magnified (S., 1 inch).

Fig. 1.

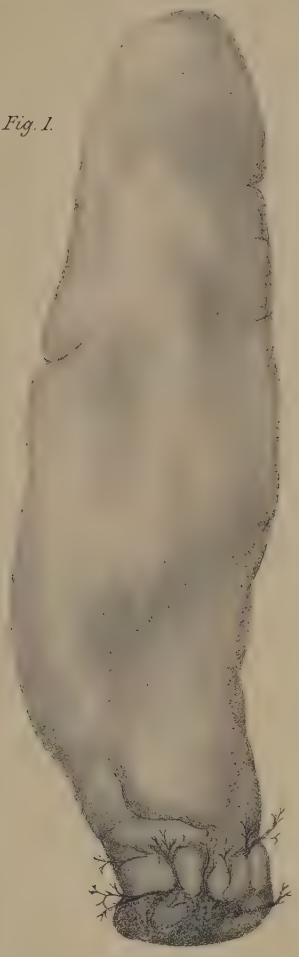


Fig. 2.

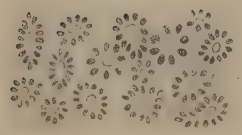


Fig. 3.

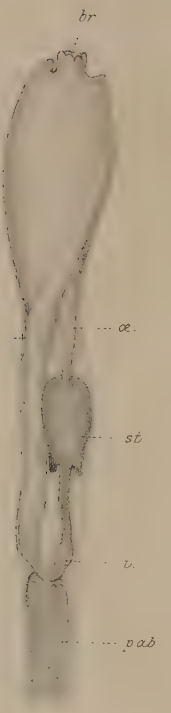


Fig. 4.

Fig. 5.

Fig. 6.

Fig. 12.

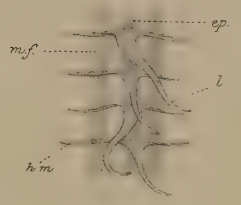


Fig. 7.

Fig. 13.

Fig. 8.

Fig. 9.

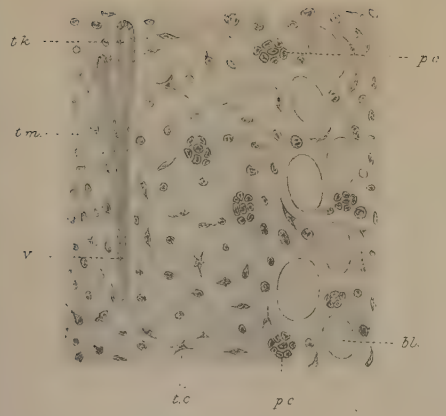


Fig. 10.

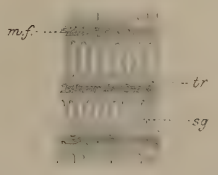
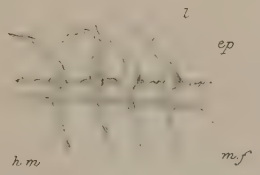


Fig. 11.



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FIGS. 1-6, ATOPOGASTER GIGANTEA, n. sp. FIGS. 7-13, ATOPOGASTER AURANTIACA, n. sp.

PLATE XXIV.

PLATE XXIV.

Figs. 1–8. *Atopogaster elongata*, n. sp.
Figs. 9, 10. *Atopogaster elongata*, var. *pallida*, nov.
Figs. 11–15. *Atopogaster informis*, n. sp.
Figs. 16–20. *Morchellioides affinis*, n. sp.

ab. Abdomen of Ascidiozooid.
ar. Prolongation of branchial sac in post-abdomen.
at. Atrial aperture.
a.z. Ascidiozooid.
br. Branchial aperture.
br.l. Lobe of branchial aperture.
cæ. Cæcal thickening in wall of stomach.
cæl. Space in mesoderm of post-abdomen.
d.l. Dorsal lamina.
ec. Ectoderm.
end. Endoderm.
i. Intestine.
l. Languet.
mes. Mesoderm cells.
m.f. Muscle fibres.
œ. Œsophagus.
p.ab. Post-abdomen.
r. Rectum.
sg. Stigmata of branchial sac.
sph. Sphincter.
st. Stomach.
t. Test.
t.c. Test cells.
th. Thorax of Ascidiozooid.
t.k. Terminal bulb on vessel in test.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
v.ap. Vascular appendage.

Fig. 1. Colony of *Atopogaster elongata;* natural size.

Fig. 2. Another colony of *Atopogaster elongata;* natural size.

Fig. 3. Another colony of *Atopogaster elongata;* natural size.

Fig. 4. Ascidiozooid of *Atopogaster elongata*, seen from right side; magnified (S., 1 inch).

Fig. 5. Part of test of *Atopogaster elongata;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 6. Part of branchial sac of *Atopogaster elongata;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 7. Diagram of alimentary canal of *Atopogaster elongata;* magnified (S., 1 inch, enlarged).

Fig. 8. Transverse section of post-abdomen of *Atopogaster elongata;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 9. Colony of *Atopogaster elongata*, var. *pallida;* natural size.

Fig. 10. Part of section of test of *Atopogaster elongata*, var. *pallida;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 11. Part of section of colony of *Atopogaster informis;* natural size.

Fig. 12. Part of branchial sac of *Atopogaster informis;* magnified (S., 1 inch).

Fig. 13. Part of another branchial sac of *Atopogaster informis;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 14. Part of dorsal lamina of *Atopogaster informis*, seen from the side; magnified (S., 1 inch).

Fig. 15. Larva of *Atopogaster informis;* magnified (S., 1 inch).

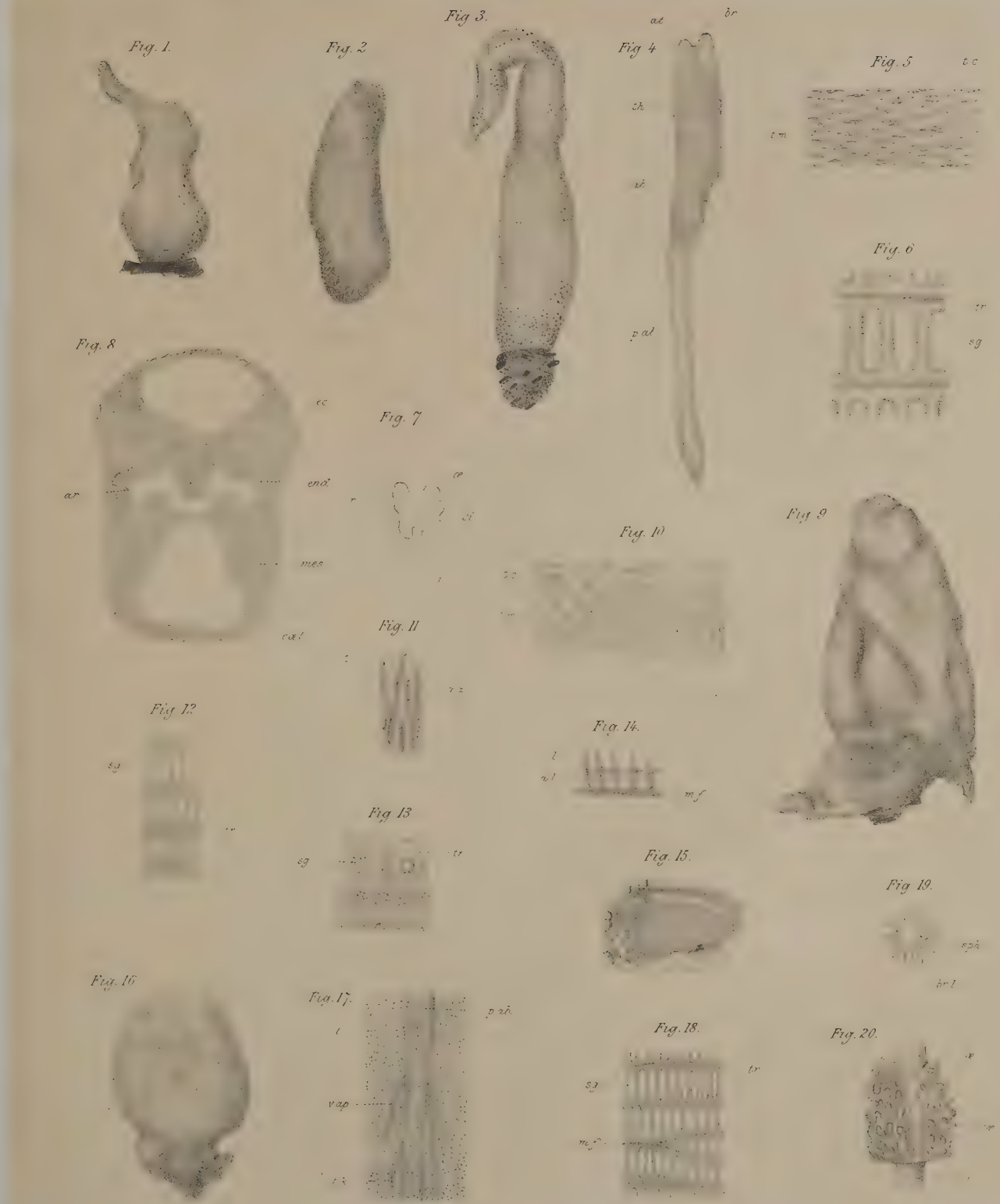
Fig. 16. Colony of *Morchellioides affinis;* natural size.

Fig. 17. Section through test of *Morchellioides affinis*, showing end of post-abdomen of Ascidiozooid and branched vascular appendages ending in bulbs; magnified (S., 1 inch).

Fig. 18. Part of branchial sac of *Morchellioides affinis*, showing a transverse vessel branching; magnified (S., 1 inch).

Fig. 19. Branchial aperture of Ascidiozooid of *Morchellioides affinis*, from above, showing eight lobes; magnified (S., 1 inch).

Fig. 20. Stomach of Ascidiozooid of *Morchellioides affinis*, showing irregular thickening of walls; magnified (S., 1 inch).



FIGS 1 8, ATOPOGASTER ELONGATA, n. sp FIGS 9 & 10, ATOPOGASTER ELONGATA var PALLIDA, nov.
FIGS 11-15, ATOPOGASTER INFORMIS, n sp FIGS 16-20, MORCHELLIOIDES AFFINIS, n. sp

PLATE XXV.

PLATE XXV.

Figs. 1–3. *Morchellium giardi*, n. sp.
Figs. 4–6. *Sidnyum pallidum*, n. sp.
Figs. 7–9. *Polyclinum molle*, n. sp.
Figs. 10–12. *Polyclinum minutum*, n. sp.
Figs. 13, 14. *Amaroucium hepaticum*, n. sp.
Figs. 15, 16. *Aplidium crassum*, n. sp.

at. Atrial aperture.
ab. Abdomen.
bl. Bladder cell.
br.l. Lobe of branchial aperture.
en. Endostyle.
h.m. Horizontal membrane of branchial sac.
i. Intestine.
m.f. Muscle fibres.
o. Ova.
œ. Œsophagus.
p.ab. Post-abdomen.
r. Rectum.
sg. Stigmata of branchial sac.
sg.c. Ciliated cells bounding stigmata of branchial sac.
sph. Sphincter.
st. Stomach.
t.c. Test cells.
th. Thorax.
t.k. Terminal bulb on vessel in test.
tr. Transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v. Vessel in test.
v.d. Vas deferens.

Fig. 1. Colony of *Morchellium giardi;* natural size.

Fig. 2. Part of branchial sac of *Morchellium giardi;* magnified (S., 1 inch).

Fig. 3. Stomach of *Morchellium giardi*, showing irregular thickening of wall; magnified (S., 1 inch).

Fig. 4. Colony of *Sidnyum pallidum;* natural size.

Fig. 5. Part of branchial sac of *Sidnyum pallidum;* magnified (S., 1 inch).

Fig. 6. Ascidiozooid of *Sidnyum pallidum*, from left side; magnified (S., 1 inch).

Fig. 7. Colony of *Polyclinum molle;* natural size.

Fig. 8. Part of branchial sac of *Polyclinum molle;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 9. Ascidiozooid of *Polyclinum molle*, seen from right side; magnified (S., 1 inch).

Fig. 10. Colony of *Polyclinum minutum;* natural size.

Fig. 11. Ascidiozooid of *Polyclinum minutum*, seen from right side; magnified (S., 1 inch).

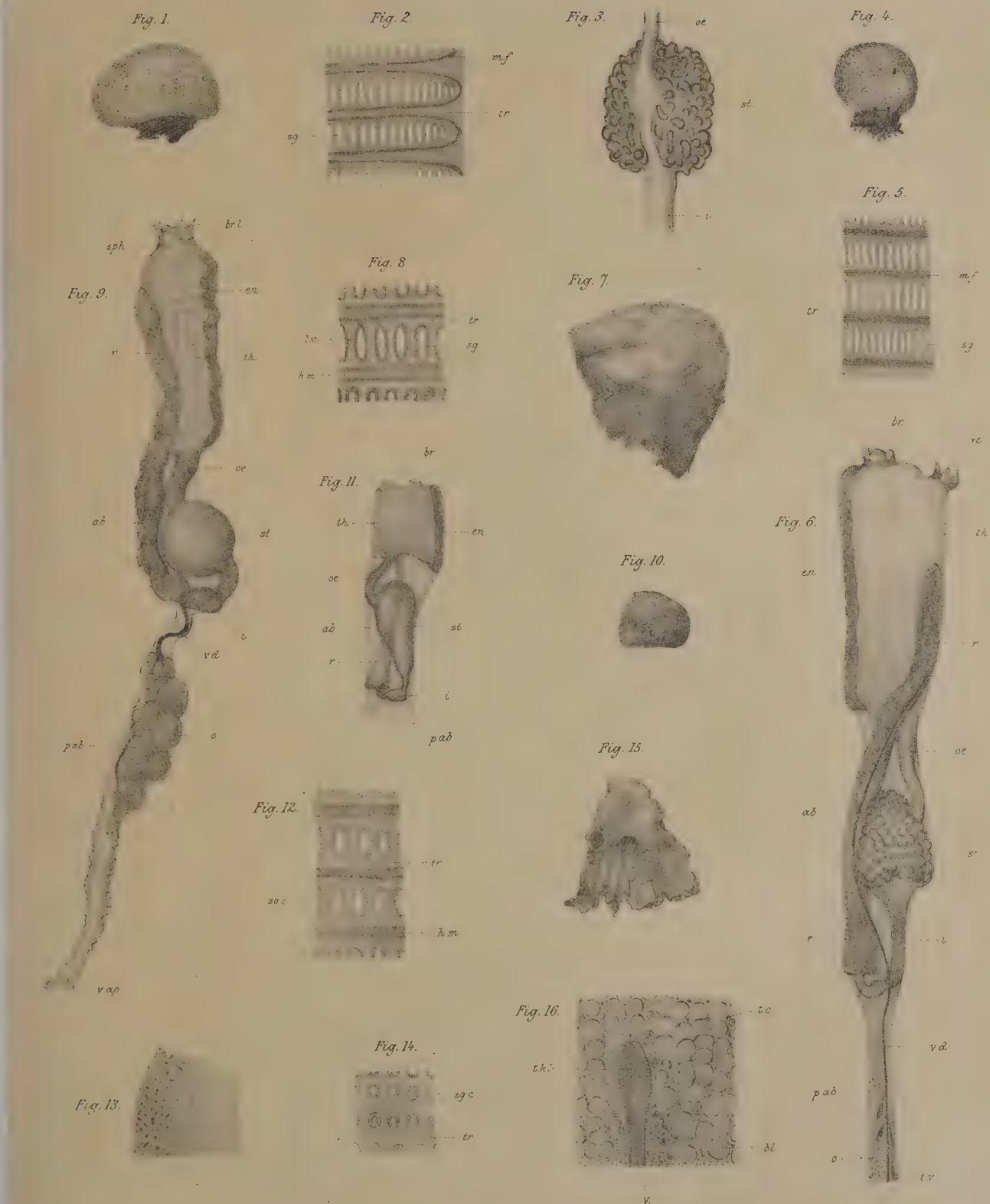
Fig. 12. Part of branchial sac of *Polyclinum minutum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 13. Part of slice of colony of *Amaroucium hepaticum;* natural size.

Fig. 14. Part of branchial sac of *Amaroucium hepaticum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 15. Colony of *Aplidium crassum;* natural size.

Fig. 16. Part of section of test of *Aplidium crassum;* highly magnified (S., $\frac{1}{6}$ inch).



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FIGS 1-3, MORCHELLIUM GIARDI, n. sp. FIGS 4-6, SIDNYUM PALLIDUM, n. sp. FIGS 7-9, POLYCLINUM MOLLE, n. sp.
FIGS 10-12, POLYCLINUM MINUTUM, n. sp. FIGS 13 & 14, AMAROUCIUM HEPATICUM n. sp. FIGS 15 & 16, APLIDIUM CRASSUM, n. sp.

PLATE XXVI.

PLATE XXVI.

Figs. 1–4. *Polyclinum pyriforme*, n. sp.
Figs. 5–7. *Polyclinum depressum*, n. sp.
Figs. 8, 9. *Aplidium fumigatum*, n. sp.
Fig. 10. *Polyclinum incertum*, n. sp.
Figs. 11, 12. *Amaroucium albidum*, n. sp.

ab. Abdomen.
at. Atrial aperture.
br. Branchial aperture.
en. Endostyle.
h.m. Horizontal membrane of branchial sac.
i. Intestine.
i'. Constriction between intestine and rectum.
l. Dorsal languet.
m.f. Muscle fibres.
œ. Œsophagus.
p.ab. Post-abdomen.
r. Rectum.
sg. Stigmata of branchial sac.
st. Stomach.
t.c. Test cells.
t.c'. Modified test cells.
th. Thorax.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
v.d. Vas deferens.

Fig. 1. Colony of *Polyclinum pyriforme;* natural size.

Fig. 2. Part of branchial sac of *Polyclinum pyriforme;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 3. Part of dorsal edge of branchial sac of *Polyclinum pyriforme*, showing languets; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Ascidiozooid of *Polyclinum pyriforme*, seen from right side; magnified (S., 1 inch).

Fig. 5. Colony of *Polyclinum depressum*, seen from upper surface; natural size.

Fig. 6. Ascidiozooid of *Polyclinum depressum*, seen from left side; magnified (S., 1 inch).

Fig. 7. Another Ascidiozooid of *Polyclinum depressum*, seen from right side; magnified (S., 1 inch).

Fig. 8. Colony of *Aplidium fumigatum;* natural size.

Fig. 9. Part of test of *Aplidium fumigatum;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 10. Colony of *Polyclinum incertum;* natural size.

Fig. 11. Colony of *Amaroucium albidum;* natural size.

Fig. 12. Part of section of colony of *Amaroucium albidum*, showing transverse sections of the post-abdomen of Ascidiozooids; magnified (S., 1 inch).

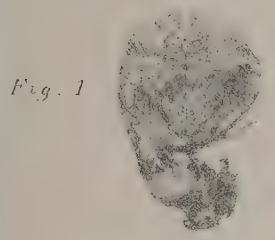

Fig. 1

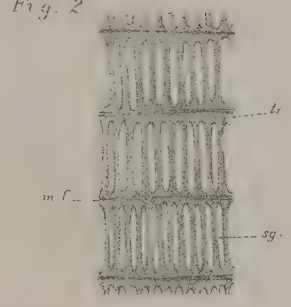

Fig. 2

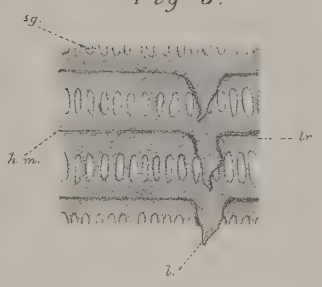

Fig. 3.

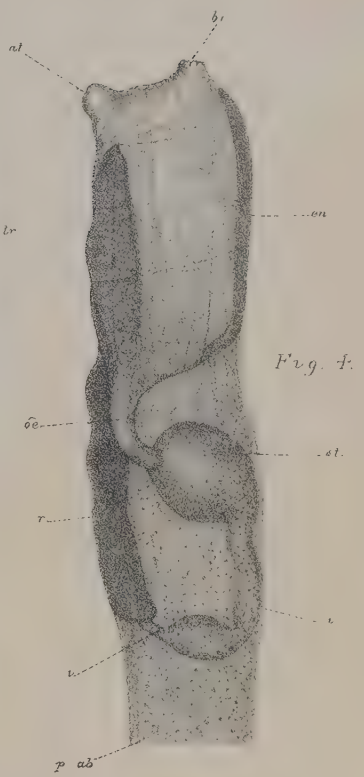

Fig. 4.

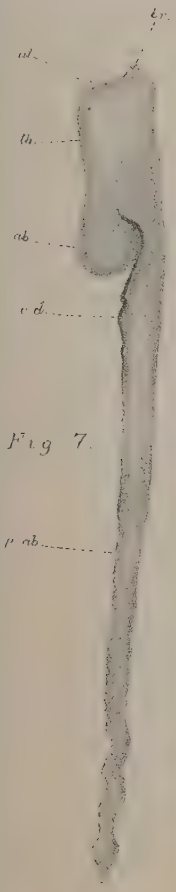

Fig 7.

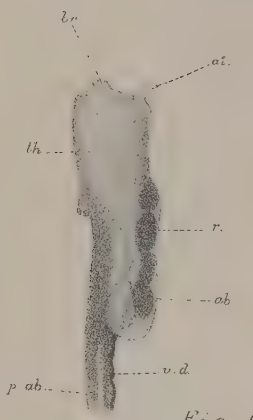

Fig 6.

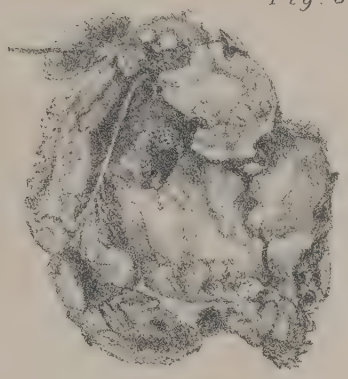

Fig. 5.

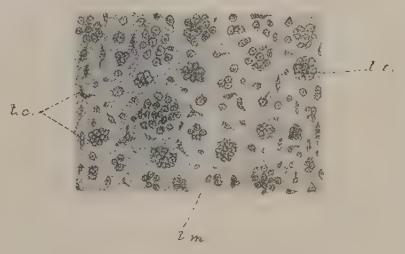

Fig 9.

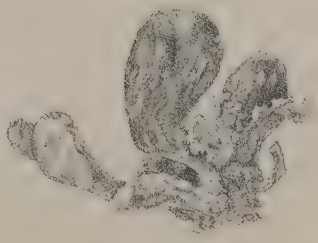

Fig. 8.

Fig 11.

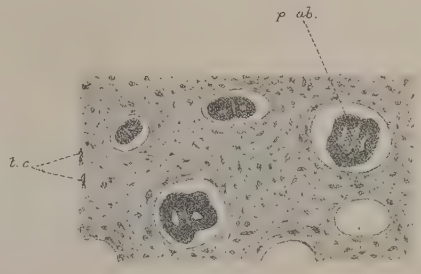

Fig. 12.

Fig. 10.

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FIGS 1-4, POLYCLINUM PYRIFORME, n.sp. FIGS 8-9, APLIDIUM FUMIGATUM, n.sp.
FIGS 5-7, POLYCLINUM DEPRESSUM, n.sp. FIG. 10, POLYCLINUM INCERTUM, n.sp.
FIGS 11-12 AMAROUCIUM ALBIDUM, n.sp.

PLATE XXVII.

PLATE XXVII.

Figs. 1, 2. ———— (?) *clava*, n. sp.
Figs. 3–8. *Aplidium incrustans*, n. sp.
Figs. 9–12. *Amaroucium colelloides*, n. sp.

bl. Bladder cell.
f.p. Foreign particle in test.
l. Languet.
l.v. Fine longitudinal vessels of branchial sac.
m.f. Muscle fibres.
o. Ovum.
o.s. Outer surface of test.
p.c. Pigment cell in test.
pig. Mass of pigment cells.
sg. Stigmata of branchial sac.
sph. Sphincter.
t.c. Test cells.
t.k. Terminal bulb on vessel in test.
t.m. Test matrix.
tn, tn'. Tentacles.
tr. Transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v.ap. Vascular appendage.
v.d. Vas deferens.

Fig. 1. Colony of ———— (?) *clava*; natural size.

Fig. 2. Section of test of ———— (?) *clava*; magnified (S., 1 inch).

Fig. 3. Colony of *Aplidium incrustans*; natural size.

Fig. 4. Part of test of *Aplidium incrustans*, showing imbedded foreign particles; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 5. Part of branchial sac of *Aplidium incrustans*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. Three of the ciliated cells from the stigmata of *Aplidium incrustans*; more highly magnified (Z., $\frac{1}{12}$).

Fig. 7. Part of dorsal lamina of *Aplidium incrustans*, showing two languets; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 8. Tentacles of *Aplidium incrustans*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 9. Colony of *Amaroucium colelloides*; natural size.

Fig. 10. Part of branchial sac of *Amaroucium colelloides*; magnified (S., 1 inch).

Fig. 11. Reproductive organs of *Amaroucium colelloides* in post-abdomen; magnified (S., 1 inch).

Fig. 12. Larva of *Amaroucium colelloides*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 2.

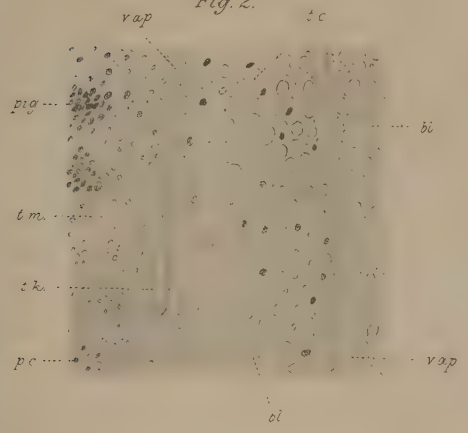


Fig. 1.

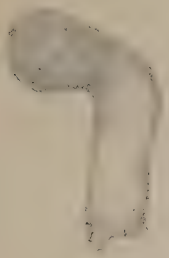


Fig. 4.

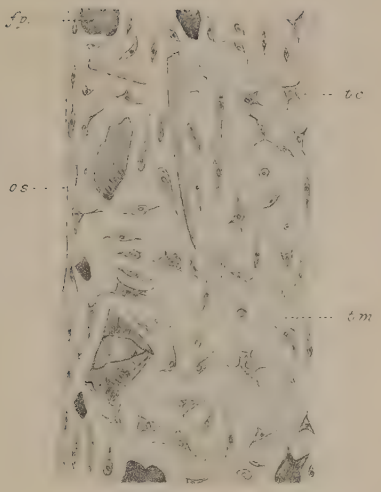


Fig. 5.

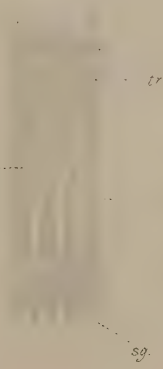


Fig. 6.

Fig. 3.

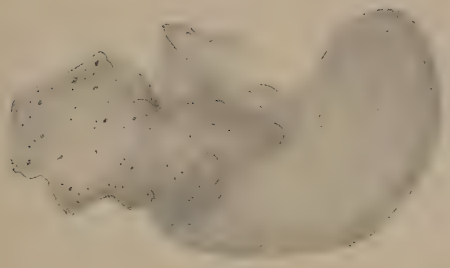


Fig. 7.

Fig. 11.

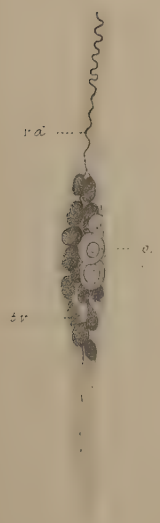


Fig. 10.

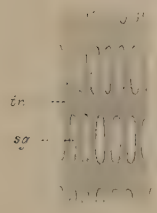
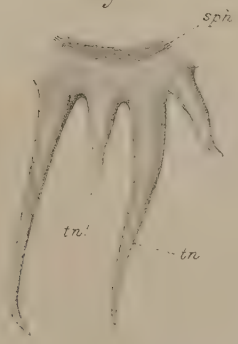


Fig. 9.

Fig. 8.



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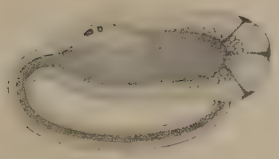

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FIGS 1 & 2, _____ (?) CLAVA n. sp. FIGS 3-8, APLIDIUM INCRUSTANS, n. sp.
FIGS 9-12, AMAROUCIUM COLELLOIDES, n. sp.

PLATE XXVIII.

PLATE XXVIII.

Figs. 1–4. *Aplidium fallax*, Johnston.
Figs. 5–7. *Aplidium leucophæum*, n. sp.
Figs. 8–10. *Aplidium fuscum*, n. sp.
Figs. 11–13. *Aplidium despectum*, n. sp.
Figs. 14, 15. ———— (?) *ignotus*, n. sp.

at. Atrial aperture.
at.l. Atrial languet.
br. Branchial aperture.
en. Endostyle.
h.m. Horizontal membrane of branchial sac.
i. Intestine.
l. Languet.
l.v. Fine longitudinal vessels of branchial sac.
p.ab. Post-abdomen.
r. Rectum.
sg. Stigmata of branchial sac.
sg'. Small stigmata.
st. Stomach.
t.c. Test cells.
t.m. Test matrix.
tr. Transverse vessels of branchial sac.

Fig. 1. Two colonies of *Aplidium fallax;* natural size.

Fig. 2. Ascidiozooid of *Aplidium fallax*, seen from left side; magnified (S., 1 inch).

Fig. 3. Part of branchial sac of *Aplidium fallax*, showing diminution of stigmata (*sg*, *sg'*) at ventral edge; magnified (S., 1 inch).

Fig. 4. Dorsal part of branchial sac of *Aplidium fallax*, showing languets; magnified (S., 1 inch).

Fig. 5. Colony of *Aplidium leucophæum;* natural size.

Fig. 6. Ascidiozooid of *Aplidium leucophæum*, seen from left side; magnified (S., 1 inch).

Fig. 7. Dorsal part of branchial sac of *Aplidium leucophæum*, showing stigmata and languets; magnified (S., 1 inch).

Fig. 8. Colony of *Aplidium fuscum;* natural size.

Fig. 9. Part of branchial sac of *Aplidium fuscum;* magnified (S., 1 inch).

Fig. 10. Anterior end of Ascidiozooid of *Aplidium fuscum*, showing branchial and atrial apertures; magnified (S., 1 inch).

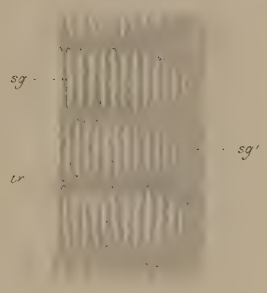
Fig. 11. Colony of *Aplidium despectum;* natural size.

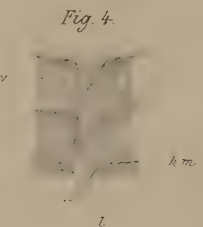
Fig. 12. Section of test of *Aplidium despectum;* highly magnified (S., $\frac{1}{6}$ inch).

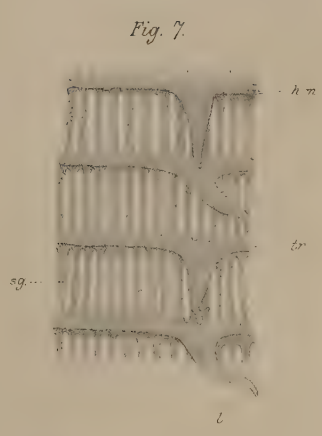
Fig. 13. Part of branchial sac of *Aplidium despectum;* highly magnified (S., $\frac{1}{4}$ inch).

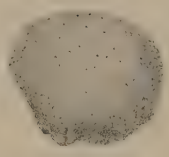
Fig. 14. Colony of ———— (?) *ignotus;* reduced (see measurements).

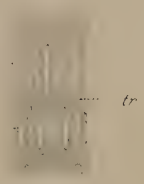
Fig. 15. Part of colony of ———— (?) *ignotus;* natural size.

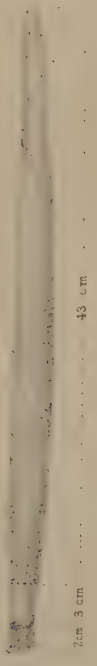


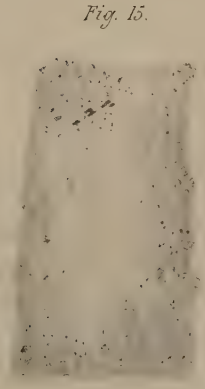


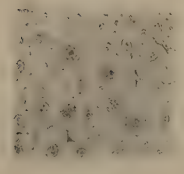


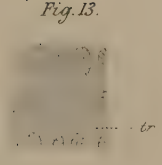












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FIGs 1-4, APLIDIUM FALLAX, Johnston FIGs 5-7, APLIDIUM LEUCOPHAEUM, n sp FIGs 8-10, APLIDIUM FUSCUM, n sp.
FIGs 11-13, APLIDIUM DESPECTUM, n sp. FIGs 14 & 15, _____ IGNOTUS, n sp

PLATE XXIX.

PLATE XXIX.

Figs. 1–5. *Amaroucium globosum*, n. sp.
Fig. 6. *Amaroucium variabile*, var. *tenerum*, nov.
Figs. 7–12. *Amaroucium variabile*, n. sp.
Figs. 13–15. *Amaroucium recumbens*, n. sp.

at. Atrial aperture.
at.l. Atrial languet.
br. Branchial aperture.
en. Endostyle.
h.m. Horizontal membrane of branchial sac.
i. Intestine.
l.v. Fine longitudinal vessels of branchial sac.
œ. Œsophagus.
p.ab. Post-abdomen.
r. Rectum.
st. Stomach.
t.c. Test cells.
th. Thorax.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v.ap'. Rudimentary vascular appendages
v.d. Vas deferens.

Fig. 1. Large colony of *Amaroucium globosum;* natural size.

Fig. 2. Smaller colony of *Amaroucium globosum;* natural size.

Fig. 3. Part of branchial sac of *Amaroucium globosum*, from the smaller colony; magnified (S., 1 inch).

Fig. 4. Ascidiozooid of *Amaroucium globosum*, seen from left side; magnified (S., 1 inch).

Fig. 5. Part of male reproductive organs of *Amaroucium globosum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. Colonies of *Amaroucium variabile*, var. *tenerum;* natural size.

Fig. 7. Colony of *Amaroucium variabile;* natural size. The specimen figured belonged to the brown variety.

Fig 8. Section of the test of *Amaroucium variabile;* highly magnified (S., $\frac{1}{6}$ inch). This section was taken from a specimen of the brown variety.

Fig. 9. Ascidiozooid of *Amaroucium variabile*, seen from right side; magnified (S., 1 inch).

Fig. 10. Anterior end of Ascidiozooid of *Amaroucium variabile*, seen from right side, showing apertures and atrial languet; magnified (S., 1 inch, enlarged).

Fig. 11. Transverse section of post-abdomen of *Amaroucium variabile;* magnified (S., 1 inch).

Fig. 12. Transverse section of stomach of *Amaroucium variabile*, showing numerous folds; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 13. Colony of *Amaroucium recumbens;* natural size.

Fig. 14. Part of branchial sac of *Amaroucium recumbens;* magnified (S., 1 inch).

Fig. 15. Ascidiozooid of *Amaroucium recumbens*, seen from right side; magnified (S., 1 inch).

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FIGs 1-5, AMAROUCIUM GLOBOSUM, n.sp FIG. 6, AMAROUCIUM VARIABILE, var. TENERUM, nov.
FIGs 7-12, AMAROUCIUM VARIABILE, n.sp FIGs 13-15, AMAROUCIUM RECUMBENS, n sp

PLATE XXX.

PLATE XXX.

Figs. 1–7. *Amaroucium irregulare*, n. sp.
Fig. 8. *Amaroucium irregulare*, var. *concinnum*, nov.
Figs. 9–11. *Amaroucium pallidulum*, n. sp.
Figs. 12–15. *Amaroucium lævigatum*, n. sp.
Figs. 16, 17. *Amaroucium complanatum*, n. sp.

abd. Abdomen.
at.l. Atrial languet.
br. Branchial aperture.
en. Endostyle.
h.m. Horizontal membrane of branchial sac.
i. Intestine.
l.v. Fine longitudinal vessels of branchial sac.
œ. Œsophagus.
p.abd. Post-abdomen.
r. Rectum.
sg. Stigmata of branchial sac.
st. Stomach.
t.c. Test cells.
th. Thorax.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.

Fig. 1. Colony of *Amaroucium irregulare;* natural size.

Fig. 2. Another colony of *Amaroucium irregulare;* natural size.

Fig. 3. Ascidiozooid of *Amaroucium irregulare*, seen from left side; magnified (S., 1 inch).

Fig. 4. Part of branchial sac of *Amaroucium irregulare;* magnified (S., 1 inch, enlarged).

Fig. 5. Stomach of *Amaroucium irregulare*, seen in optical section; magnified (S., 1 inch, enlarged).

Fig. 6. Alimentary canal of *Amaroucium irregulare;* magnified (S., 1 inch, enlarged).

Fig. 7. Transverse section of abdomen of *Amaroucium irregulare*, showing folds in stomach and rectum; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 8. Colony of *Amaroucium irregulare*, var. *concinnum;* natural size.

Fig. 9. Colony of *Amaroucium pallidulum;* natural size.

Fig. 10. Part of branchial sac of *Amaroucium pallidulum;* magnified (S., 1 inch).

Fig. 11. Larva of *Amaroucium pallidulum;* magnified (S., 1 inch).

Fig. 12. Colony of *Amaroucium lævigatum;* natural size.

Fig. 13. Ascidiozooid of *Amaroucium lævigatum*, seen from right side; magnified (S., 1 inch).

Fig. 14. Part of branchial sac of *Amaroucium lævigatum;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 15. Section of test of *Amaroucium lævigatum;* highly magnified (S., $\frac{1}{6}$ inch), showing arrangement of modified test cells (*t.c.*).

Fig. 16. Colony of *Amaroucium complanatum;* natural size.

Fig. 17. Part of branchial sac of *Amaroucium complanatum;* magnified (S., 1 inch, enlarged).

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FIGs 1-7, AMAROUCIUM IRREGULARE, n. sp. FIG. 8, AMAROUCIUM IRREGULARE, var. CONCINNUM, nov.
FIGs 9-11, AMAROUCIUM PALLIDULUM, n. sp. FIGs 12-15, AMAROUCIUM LAEVIGATUM, n. sp.
FIGs 16 & 17, AMAROUCIUM COMPLANATUM, n. sp.

PLATE XXXI.

PLATE XXXI.

Figs. 1–4. *Psammaplidium rude*, n. sp.
Figs. 5–10. *Psammaplidium subviride*, n. sp.
Figs. 11, 12. *Psammaplidium exiguum*, n. sp.
Figs. 13–16. *Psammaplidium ovatum*, n. sp.
Figs. 17–19. *Amaroucium nigrum*, n. sp.

at. Atrial aperture.
at.l. Atrial languet.
br. Branchial aperture.
br.s. Branchial sac.
en. Endostyle.
l. Languet.
l.v. Fine longitudinal vessels of branchial sac.
m. Mantle.
m.b. Muscle band in mantle.
m.f. Muscle fibres.
n.g. Nerve ganglion.
o. Ovum.
œ. Œsophagus.
p.abd. Post-abdomen.
p.br. Peribranchial cavity.
p.c. Pigment cell.
sg. Stigmata of branchial sac.
t.c. Test cells.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v.d. Vas deferens.

Fig. 1. Colony of *Psammaplidium rude;* natural size.

Fig. 2. Another colony of *Psammaplidium rude;* natural size.

Fig. 3. Anterior end of Ascidiozooid of *Psammaplidium rude*, seen from right side, showing apertures and atrial languet; magnified (S., 1 inch).

Fig. 4. Dorsal part of branchial sac of *Psammaplidium rude*, showing languets; magnified (S., 1 inch).

Fig. 5. Colony of *Psammaplidium subviride;* natural size.

Fig. 6. Part of branchial sac of *Psammaplidium subviride;* magnified (S., 1 inch).

Fig. 7. Anterior end of Ascidiozooid of *Psammaplidium subviride*, showing atrial languet; magnified (S., 1 inch).

Fig. 8. Dorsal languet of *Psammaplidium subviride;* magnified (S., 1 inch).

Fig. 9. Section of test of *Psammaplidium subviride*, showing imbedded foreign particles; magnified (S., 1 inch).

Fig. 10. Part of post-abdomen of *Psammaplidium subviride*, showing ova and spermatic vesicles; magnified (S., 1 inch).

Fig. 11. Colony of *Psammaplidium exiguum;* natural size.

Fig. 12. Part of branchial sac of *Psammaplidium exiguum;* magnified (S., 1 inch).

Fig. 13. Colony of *Psammaplidium ovatum;* natural size.

Fig. 14. Part of branchial sac of *Psammaplidium ovatum;* magnified (S., 1 inch)

Fig. 15. Ascidiozooid of *Psammaplidium ovatum*, seen from ventral edge; magnified (S., 1 inch).

Fig. 16. Anterior part of young Ascidiozooid of *Psammaplidium ovatum*, cut open; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 17. Colony of *Amaroucium nigrum;* natural size.

Fig. 18. Section through test of *Amaroucium nigrum*, showing test cells; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 19. Part of mantle of *Amaroucium nigrum*, showing muscle bands and pigment cells; highly magnified (S., $\frac{1}{8}$ inch).

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FIGS 1-4, PSAMMAPLIDIUM RUDE, n sp
FIGS 5-10, PSAMMAPLIDIUM SUBVIRIDE, n sp.
FIGS 11 & 12, PSAMMAPLIDIUM EXIGUUM, n sp
FIGS 13-16, PSAMMAPLIDIUM OVATUM, n sp.
FIGS 17-19, AMAROUCIUM NIGRUM, n. sp

PLATE XXXII.

PLATE XXXII.

Figs. 1–5. *Psammaplidium spongiforme*, n. sp.
Figs. 6, 7. *Psammaplidium effrenatum*, n. sp.
Figs. 8–10. *Psammaplidium retiforme*, n. sp.
Figs. 11–13. *Psammaplidium flavum*, n. sp.

a. Anus.	*m.* Mantle.	*st.* Stomach.
ab. Abdomen.	*m.b.* Muscle band in mantle.	*t.c.* Modified test cells.
at. Atrial aperture.	*œ.* Œsophagus.	*t.f.* Fibrous band in the test.
br. Branchial aperture.	*p.ab* Post-abdomen.	*t.m.* Test matrix.
br.l. Branchial lobe.	*r.* Rectum.	*tr.* Transverse vessel of branchial sac.
en. Endostyle.	*sg.* Stigmata of branchial sac.	*t.v.* Spermatic vesicles.
i. Intestine.		

Fig. 1. Large colony of *Psammaplidium spongiforme*; natural size.

Fig. 2. Ascidiozooid of *Psammaplidium spongiforme*, seen from right side; magnified (S., 1 inch).

Fig. 3. Part of branchial sac of *Psammaplidium spongiforme*, with unusually large stigmata; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Part of another branchial sac of *Psammaplidium spongiforme*, showing stigmata of the ordinary size; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Alimentary canal and post-abdomen of *Psammaplidium spongiforme*; magnified (S., 1 inch, enlarged).

Fig. 6. Colony of *Psammaplidium effrenatum*; natural size.

Fig. 7. Part of mantle of *Psammaplidium effrenatum*; magnified (S., 1 inch).

Fig. 8. Colony of *Psammaplidium retiforme*; natural size.

Fig. 9. Part of branchial sac of *Psammaplidium retiforme*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Branchial siphon and lobes of *Psammaplidium retiforme*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 11. Colony of *Psammaplidium flavum*; natural size.

Fig. 12. Part of surface layer of test seen from interior; magnified (S., 1 inch).

Fig. 13. Small portion of surface layer of test seen in section, showing the fibrous bands of test matrix which separate the masses of modified test cells; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 2.

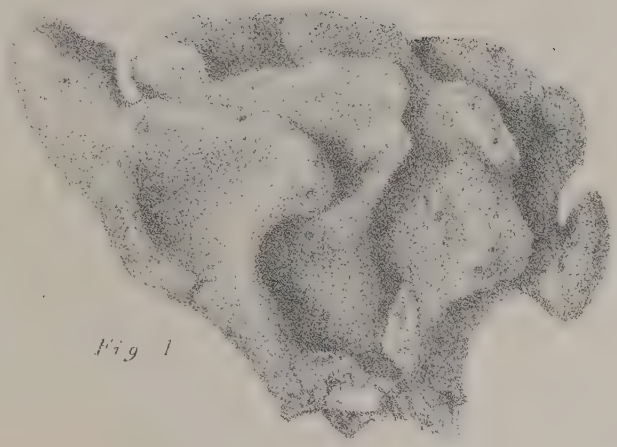


Fig. 1

Fig. 5

Fig. 3

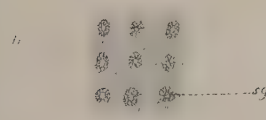


Fig. 4.

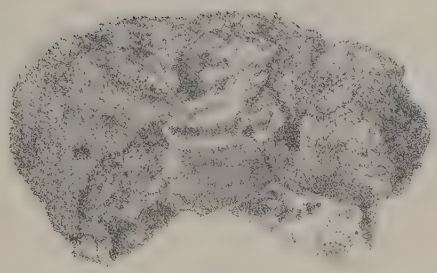


Fig. 6.

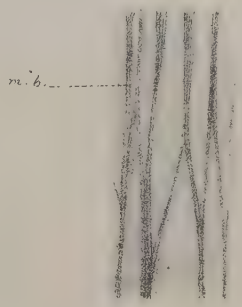


Fig. 7

Fig. 10.

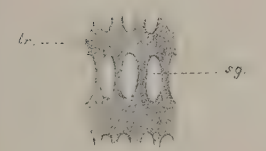
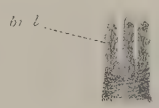


Fig. 9



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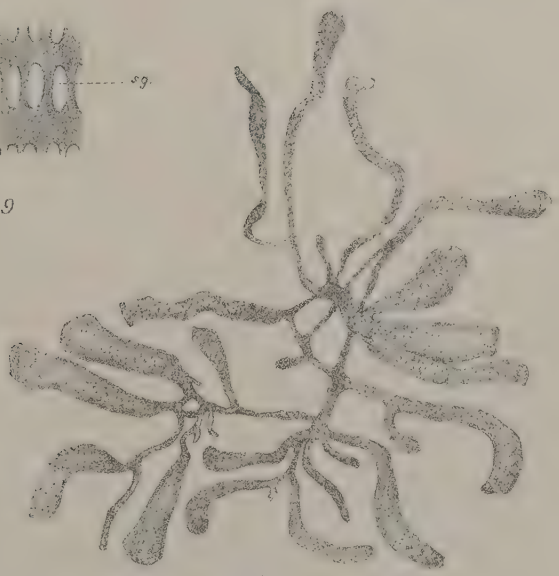

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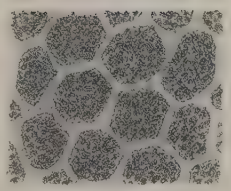

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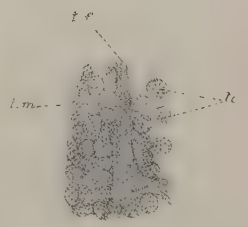

Fig. 13.

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FIGS 1-5, PSAMMAPLIDIUM SPONGIFORME, n. sp.
FIGS 6-7, PSAMMAPLIDIUM EFFRENATUM, n. sp.
FIGS 8-10, PSAMMAPLIDIUM RETIFORME, n. sp.
FIGS 11-13, PSAMMAPLIDIUM FLAVUM, n. sp.

PLATE XXXIII.

PLATE XXXIII.

Figs. 1–8. *Didemnum aurantiacum*, n. sp.
Figs. 9–15. *Leptoclinum rubicundum*, n. sp.

br. Branchial aperture.	*sg.* Stigmata of branchial sac.	*tn.* Tentacles.
en. Endostyle.	*sp.* Calcareous spicule in test.	*tr.* Transverse vessel of branchial sac.
n.g. Nerve ganglion.	*sph.* Sphincter.	*v.ap.* Vascular appendage.
p.p. Peripharyngeal band.	*t.c.* Test cells.	

Fig. 1. Colony of *Didemnum aurantiacum;* natural size.

Fig. 2. A small portion of the surface layer of test of *Didemnum aurantiacum;* enlarged.

Fig. 3. One of the branchial apertures seen from the surface; magnified (S., 1 inch).

Fig. 4. Section of the test in its deeper part; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. One of the branchial apertures seen from the inside, showing sphincter muscle, and three lobes; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. Spicules from the test; *a* shows the most common form; highly magnified (enlarged from S., $\frac{1}{4}$ inch).

Fig. 7. A small portion of the wall of the large testis, with the vas deferens coiled round it; magnified (S., 1 inch).

Fig. 8. One of the large tailed larvæ of *Didemnum aurantiacum;* magnified (S., 1 inch).

Fig. 9. Colony of *Leptoclinum rubicundum;* natural size.

Fig. 10. Part of the outer layer of the colony, including the anterior parts of the Ascidiozooids, seen from the inside; magnified (S., 1 inch).

Fig. 11. Part of the surface of the colony, seen from the outside; magnified (S., 1 inch, enlarged).

Fig. 12. Spicules from the test of *Leptoclinum rubicundum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 13. Part of the branchial sac of a young Ascidiozooid of *Leptoclinum rubicundum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 14. Part of the branchial sac of an adult Ascidiozooid of *Leptoclinum rubicundum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 15. The anterior end of an Ascidiozooid, seen from the inside, and showing endostyle, nerve ganglion, peripharyngeal band, tentacles, sphincter, branchialaperture, &c.: highly magnified (S., $\frac{1}{4}$ inch).

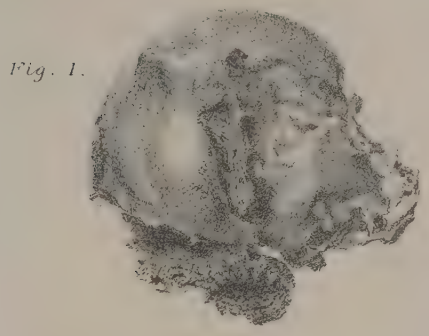


Fig. 1.

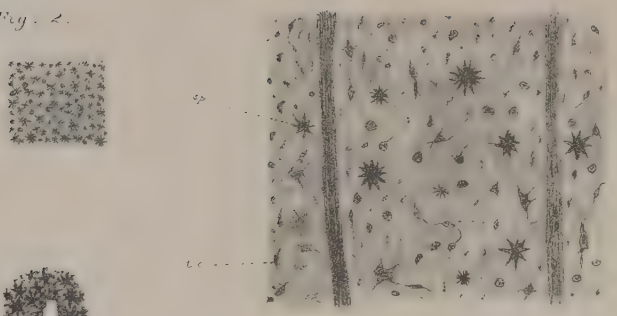


Fig. 2.

Fig. 3

Fig. 4

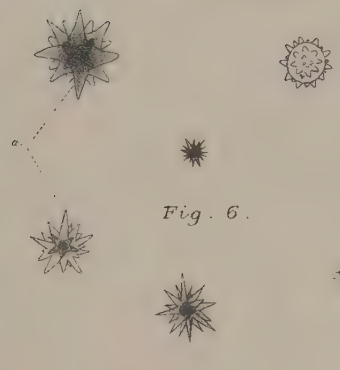
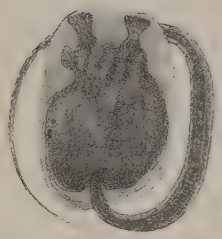


Fig. 6.

Fig. 5



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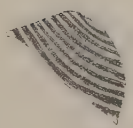

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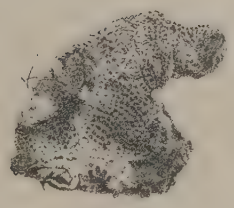

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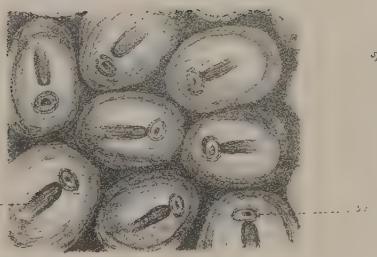
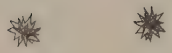


Fig. 10.

Fig. 11.



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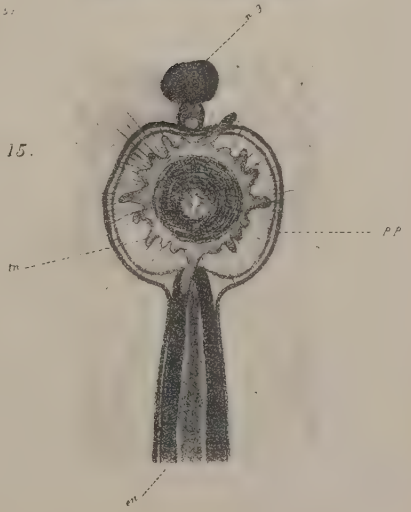

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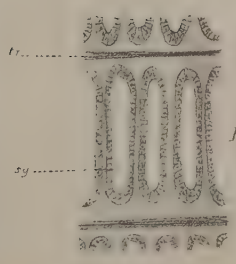

Fig. 14.

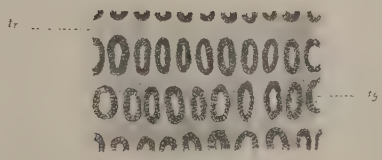

Fig. 13.

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FIGS 1-8. DIDEMNUM AURANTIACUM, n. sp.
FIGS 9-15. LEPTOCLINUM RUBICUNDUM, n. sp.

PLATE XXXIV.

PLATE XXXIV.

Figs. 1–5. *Didemnum savignii*, n. sp.
Figs. 6, 7. *Didemnum* (?) *inerme*, n. sp.
Figs. 8–13. *Leptoclinum speciosum*, var. *asperum*, nov.
Fig. 14. *Leptoclinum annectens*, n. sp.

bl. Bladder cell.	*œ.* Œsophagus.	*t.c.* Test cells.
br. Branchial aperture.	*p.c.* Mass of pigment cells.	*th.* Thorax.
en. Endostyle.	*r.* Rectum.	*t.m.* Test matrix.
i. Intestine.	*sg.* Stigmata of branchial sac.	*tr.* Transverse vessel of branchial sac.
m.f. Muscle fibres.	*sp.* Calcareous spicule in test.	*v.ap.* Vascular appendage.
o. Ovum.	*st.* Stomach.	*v.d.* Vas deferens.

Fig. 1. Colony of *Didemnum savignii;* natural size.

Fig. 2. Ascidiozooid of *Didemnum savignii*, seen from right side; magnified (S., 1 inch).

Fig. 3. Part of section of test of *Didemnum savignii;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 4. Three spicules from test of *Didemnum savignii*, showing different forms; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 5. Part of branchial sac of *Didemnum savignii;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 6. Colony of *Didemnum inerme;* natural size.

Fig. 7. Section of test of *Didemnum inerme;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 8. Large colony of *Leptoclinum speciosum*, var. *asperum;* natural size.

Fig. 9. Vertical section of colony of *Leptoclinum speciosum*, var. *asperum*, showing the arrangement of the spicules in the test and the structure of the Ascidiozooids, &c.; magnified (S., 1 inch).

Fig. 10. Section of superficial layer of colony of *Leptoclinum speciosum*, var. *asperum*, showing structure of test and arrangement of spicules; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 11. Diagrammatic optical section of spicule from test of *Leptoclinum speciosum*, var. *asperum;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 12. Diagram of wedge-shaped element of spicule; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 13. Circle of tentacles of *Leptoclinum speciosum*, var. *asperum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 14. Colony of *Leptoclinum annectens;* natural size.

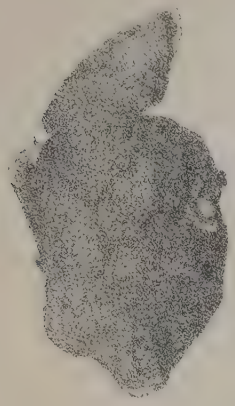

Fig. 1.

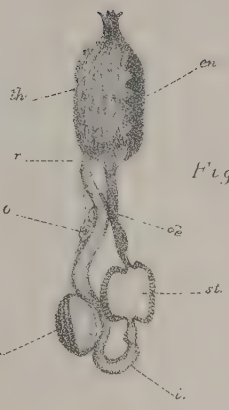

Fig. 2.

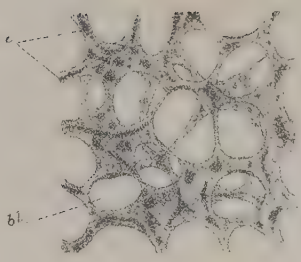

Fig. 3.

Fig. 4.

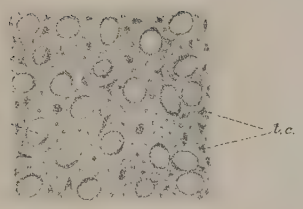

Fig. 7.

Fig. 6.

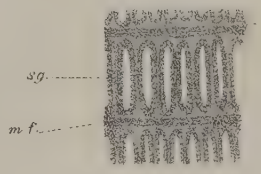

Fig. 5.

Fig. 8.

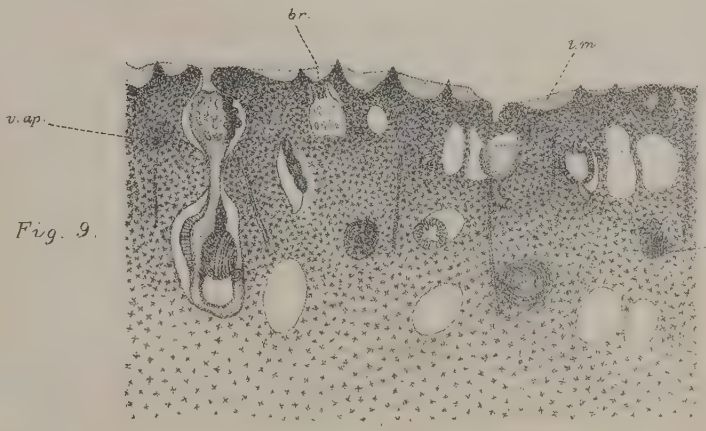

Fig. 9.

Fig. 13.

Fig. 11.

Fig. 12.

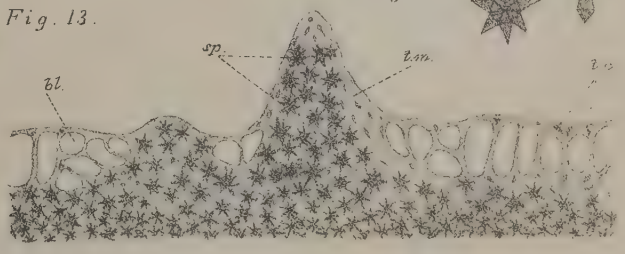

Fig. 10.

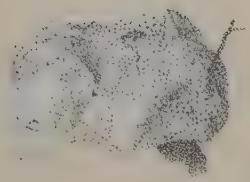

Fig. 14.

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FIGS 1-5, DIDEMNUM SAVIGNII, n. sp
FIGS 6-7, DIDEMNUM (?) INERME, n. sp.

FIGS 8-13, LEPTOCLINUM SPECIOSUM, var. ASPERUM, nov
FIG. 14, LEPTOCLINUM ANNECTENS, n. sp

PLATE XXXV.

PLATE XXXV.

Figs. 1–10. *Leptoclinum tonga*, n. sp.
Figs. 11–14. *Leptoclinum albidum*, var. *grande*, nov.

ad. Adhering process of test.	*sp.* Calcareous spicule in test.	*t.m.* Test matrix.
br. Branchial aperture.	*sph.* Sphincter.	*tn. tn'.* Tentacles.
l.s. Lower surface of colony.	*t.c.* Test cell.	

Fig. 1. Colony of *Leptoclinum tonga;* natural size.

Fig. 2. Part of a section, showing the anterior end of an Ascidiozooid cut vertically; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 3. Part of a section of the lower surface of the colony, showing the adhering prolongations of test; magnified (S., 1 inch).

Fig. 4. Spicules from the test; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 5. Small part of a section of the test, after decalcification in hydrochloric acid, stained in aniline blue; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. Small part of a section of the test, after decalcification in a solution of carbon dioxide for eighteen hours, stained in aniline blue; highly magnified (S., $\frac{1}{4}$ inch). 1 indicates the boundary of the vacuole, and 2 the membrane of the spicule.

Fig. 7. Small part of a section of the test, after partial decalcification in hydrochloric acid, stained in eosine; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 8. A spicule teased out and stained with aniline blue; highly magnified (Z., $\frac{1}{12}$).

Fig. 9. Another spicule similarly treated; highly magnified (Z., $\frac{1}{12}$).

Fig. 10. Small part of a section of the test, after decalcification in a solution of carbon dioxide for twenty-four hours, stained in aniline blue; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 11. Colony of *Leptoclinum albidum*, var. *grande;* natural size.

Fig. 12. Part of the surface of *Leptoclinum albidum*, var. *grande;* magnified (S., 1 inch).

Fig. 13. The branchial aperture of an Ascidiozooid of *Leptoclinum albidum*, var. *grande;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 14. Spicules from the test of *Leptoclinum albidum*, var. *grande;* highly magnified (S., $\frac{1}{6}$ inch).

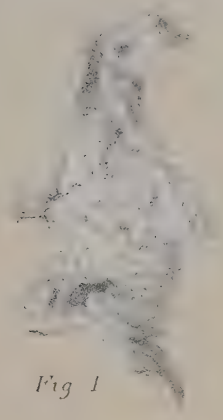

Fig 1

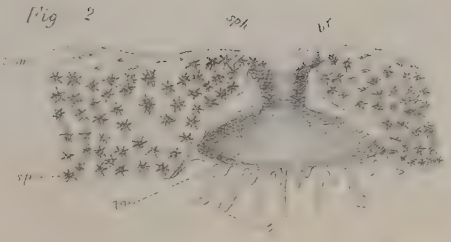

Fig 2

Fig. 3

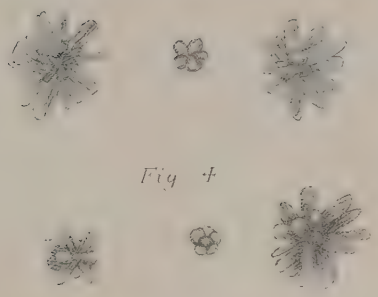

Fig 4

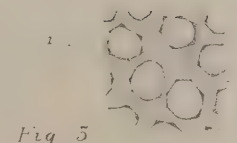

Fig 5

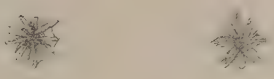

Fig 9.

Fig 8

Fig. 10.

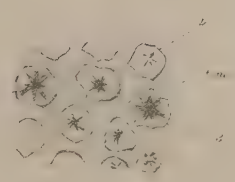

Fig. 7

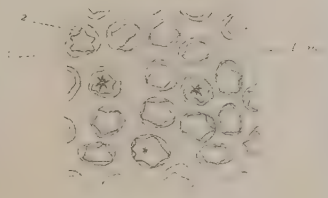

Fig 6

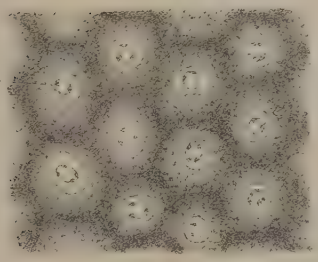

Fig. 12

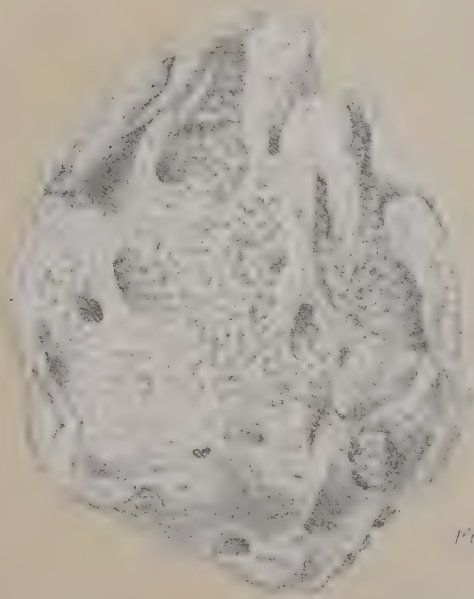

Fig 11

Fig 13.

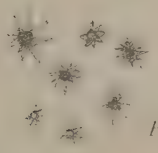

Fig 14.

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FIGS 1-10. LEPTOCLINUM TONGA, n. sp.
FIGS 11-14. LEPTOCLINUM ALBIDUM, var. GRANDE, nov.

PLATE XXXVI.

PLATE XXXVI.

Figs. 1–8. *Leptoclinum speciosum*, n. sp.
Fig. 9. *Leptoclinum speciosum*, var. *asperum*, nov.

bl. Bladder cell.	*m.b.* Muscle band in mantle.	*t.m.* Test matrix.
br. Branchial aperture.	*r.* Rectum.	*t.v.* Spermatic vesicles.
cl. Cloacal aperture.	*sp.* Calcareous spicule in test.	*v.* Vessel in test.
en. Endostyle.	*st.* Stomach.	*v.d.* Vas deferens.
l.v. Fine longitudinal vessels of branchial sac.	*t.k.* Terminal bulb on vessel in test.	

Fig. 1. Large colony of *Leptoclinum speciosum;* natural size.

Fig. 2. Part of the upper surface of *Leptoclinum speciosum;* slightly enlarged.

Fig. 3. Vertical section through a thickened part of a colony of *Leptoclinum speciosum*, showing Ascidiozooids; magnified (S., 1 inch, reduced).

Fig. 4. Part of a section through the middle of the test of *Leptoclinum speciosum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Surface view of part of ectoderm of *Leptoclinum speciosum;* highly magnified (S., $\frac{1}{4}$ inch, enlarged).

Fig. 6. Part of the mantle of *Leptoclinum speciosum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 7. Section through the testis and vas deferens of *Leptoclinum speciosum*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 8. Part of a vertical section through the colony of *Leptoclinum speciosum*, showing structure of the Ascidiozooids, &c.; magnified (S., 1 inch).

Fig. 9. Four colonies of *Leptoclinum speciosum*, var. *asperum*; natural size.

Fig. 3.

Fig. 1.

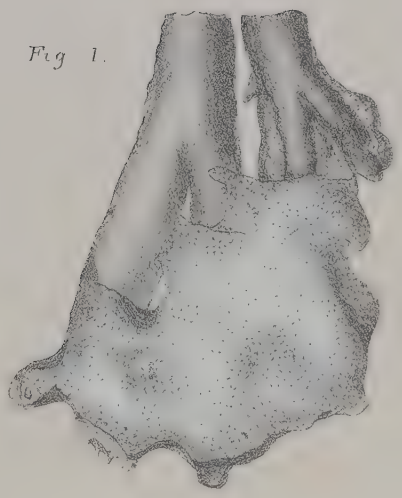

Fig. 2.

Fig. 5.

Fig. 4.

Fig. 7.

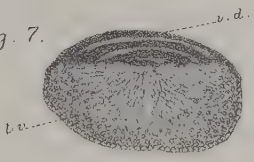

Fig. 6.

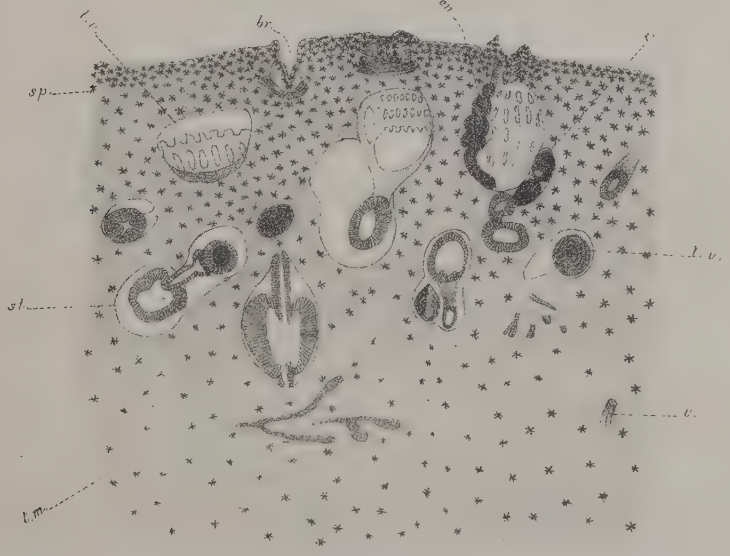

Fig. 8.

Fig. 9.

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FIGS 1-8. LEPTOCLINUM SPECIOSUM, n. sp.

FIG. 9. LEPTOCLINUM SPECIOSUM. var. ASPERUM. nov.

PLATE XXXVII.

PLATE XXXVII.

Figs. 1–8. *Cœlocormus huxleyi*, n. sp.
Figs. 9–14. *Leptoclinum moseleyi*, n. sp.

a. Anus.	*œ.* Œsophagus.	*t.* Test.
en. Endostyle.	*sg.* Stigmata of branchial sac.	*t.c.* Test cells.
i. Intestine.	*sp, sp', sp''.* Spicules in test.	*t.m.* Test matrix.
l.s. Lower surface of colony.	*sph.* Sphincter.	*tr.* Transverse vessel of branchial sac.
m. Mantle.	*st.* Stomach.	*u.s.* Upper surface of colony.
m.b. Muscle band in mantle.		

Fig. 1. Colony of *Cœlocormus huxleyi*, from the side; natural size.

Fig. 2. Colony of *Cœlocormus huxleyi*, from the edge, showing the terminal opening; natural size.

Fig. 3. Section of part of colony of *Cœlocormus huxleyi;* slightly enlarged.

Fig. 4. Spicules from test of *Cœlocormus huxleyi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Part of mantle of *Cœlocormus huxleyi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. Part of branchial sac of *Cœlocormus huxleyi;* magnified (S., 1 inch).

Fig. 7. Small part of branchial sac of *Cœlocormus huxleyi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 8. Alimentary canal of *Cœlocormus huxleyi;* magnified (S., 1 inch).

Fig. 9. Colony of *Leptoclinum moseleyi*, from upper surface; natural size.

Fig. 10. Vertical section of colony of *Leptoclinum moseleyi*, showing arrangement of spicules in test, and structure of Ascidiozooids; magnified (S., 1 inch).

Fig. 11. Part of section of test of *Leptoclinum moseleyi;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 12. Vertical section of branchial aperture of *Leptoclinum moseleyi;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 13. Œsophageal region of Ascidiozooid of *Leptoclinum moseleyi*, showing arrangement of retractor muscles; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 14. Part of branchial sac of *Leptoclinum moseleyi;* highly magnified (S., $\frac{1}{4}$ inch).

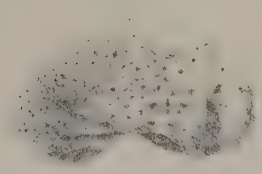


Fig 1

Fig 2.

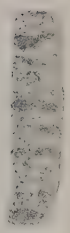


Fig 3

Fig . 5

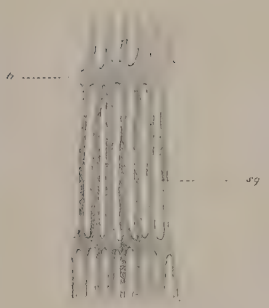


Fig 6.

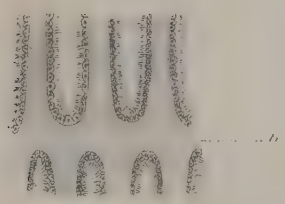


Fig 7.

Fig 4

Fig 8

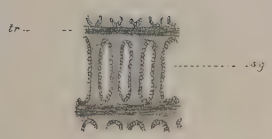


Fig . 14

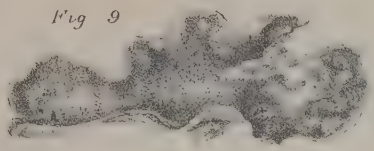


Fig 9

Fig 13.

Fig . 12.

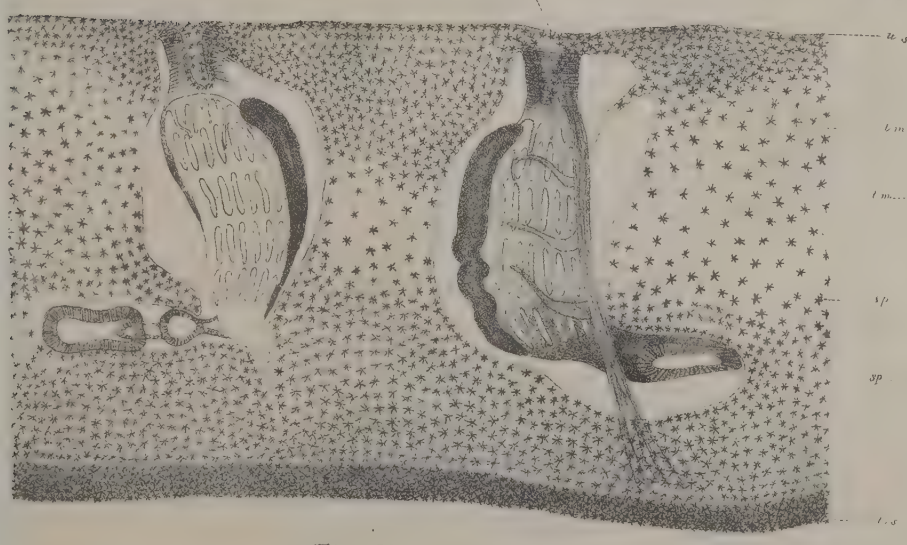


Fig . 10.

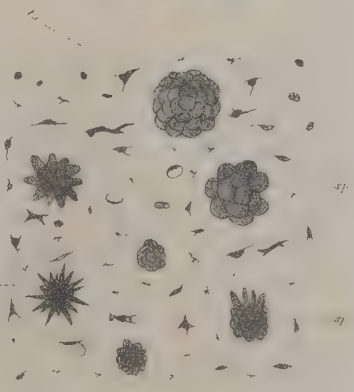


Fig 11.

FIGS 1-8, CŒLOCORMUS HUXLEYI, n.sp.
FIGS 9-14, LEPTOCLINUM MOSELEYI, n.sp.

PLATE XXXVIII.

PLATE XXXVIII.

Figs. 1–4. *Cœlocormus huxleyi*, n. sp.
Figs. 5–9. *Leptoclinum annectens*, n. sp.
Figs. 10–13. *Leptoclinum neglectum*, n. sp.
Figs. 14–18. *Leptoclinum subflavum*, n. sp.
Figs. 19–22. *Leptoclinum* (?) *jacksoni*, n. sp.

br. Branchial aperture.
cl. Cloacal aperture.
d.t. Dorsal tubercle.
en. Endostyle.
inf. Infundibulum.
m.f. Muscle fibres.
n.g. Nerve ganglion.
n.gl. Neural gland.
p.c. Pigment cell.
p.p. Peripharyngeal band.
sg. Stigmata of branchial sac.
sp. Spicules.
sph. Sphincter muscle.
t.c. Small cells in the test.
tr. Transverse vessel of branchial sac.
tn, tn'. Large and small tentacles.
u.s. Lower surface of colony.
v.ap. Vascular appendage.

Fig. 1. Diagrammatic vertical section of colony of *Cœlocormus huxleyi;* natural size.

Fig. 2. Part of the surface of *Cœlocormus huxleyi*, showing pentagonal branchial apertures; enlarged.

Fig. 3. One of the branchial apertures of *Cœlocormus huxleyi*, showing lobes; magnified (S., 1 inch).

Fig. 4. The nerve ganglion, neural gland, and dorsal tubercle of *Cœlocormus huxleyi;* highly magnified (Z., $\frac{1}{12}$).

Fig. 5. Part of the surface of the colony of *Leptoclinum annectens*, showing the branchial and common cloacal apertures; enlarged.

Fig. 6. Branchial aperture of *Leptoclinum annectens*, showing lobes, sphincter, and spicules; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 7. Semi-diagrammatic view of the anterior dorsal part of the Ascidiozooid of *Leptoclinum annectens*, showing nerve ganglion, dorsal tubercle, &c.; magnified (S., $\frac{1}{4}$ inch, reduced).

Fig. 8. Part of the branchial sac of *Leptoclinum annectens;* magnified (S., 1 inch).

Fig. 9. The ventral part of the anterior end of the Ascidiozooid of *Leptoclinum annectens*, showing tentacles, &c.; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Colony of *Leptoclinum neglectum;* natural size.

Fig. 11. Part of the surface of *Leptoclinum neglectum*, showing Ascidiozooids; magnified (S., 1 inch).

Fig. 12. Branchial aperture of Ascidiozooid of *Leptoclinum neglectum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 13. Two spicules from the test of *Leptoclinum neglectum;* more highly magnified (S., $\frac{1}{6}$ inch).

Fig. 14. Colony of *Leptoclinum subflavum;* natural size.

Fig. 15. Ascidiozooid of *Leptoclinum subflavum*, seen from right side; magnified (S., 1 inch).

Fig. 16. Large flat spicule from test of *Leptoclinum subflavum;* magnified (S., 1 inch).

Fig. 17. Part of the branchial sac of *Leptoclinum subflavum;* highly magnified (S., $\frac{1}{6}$ inch).

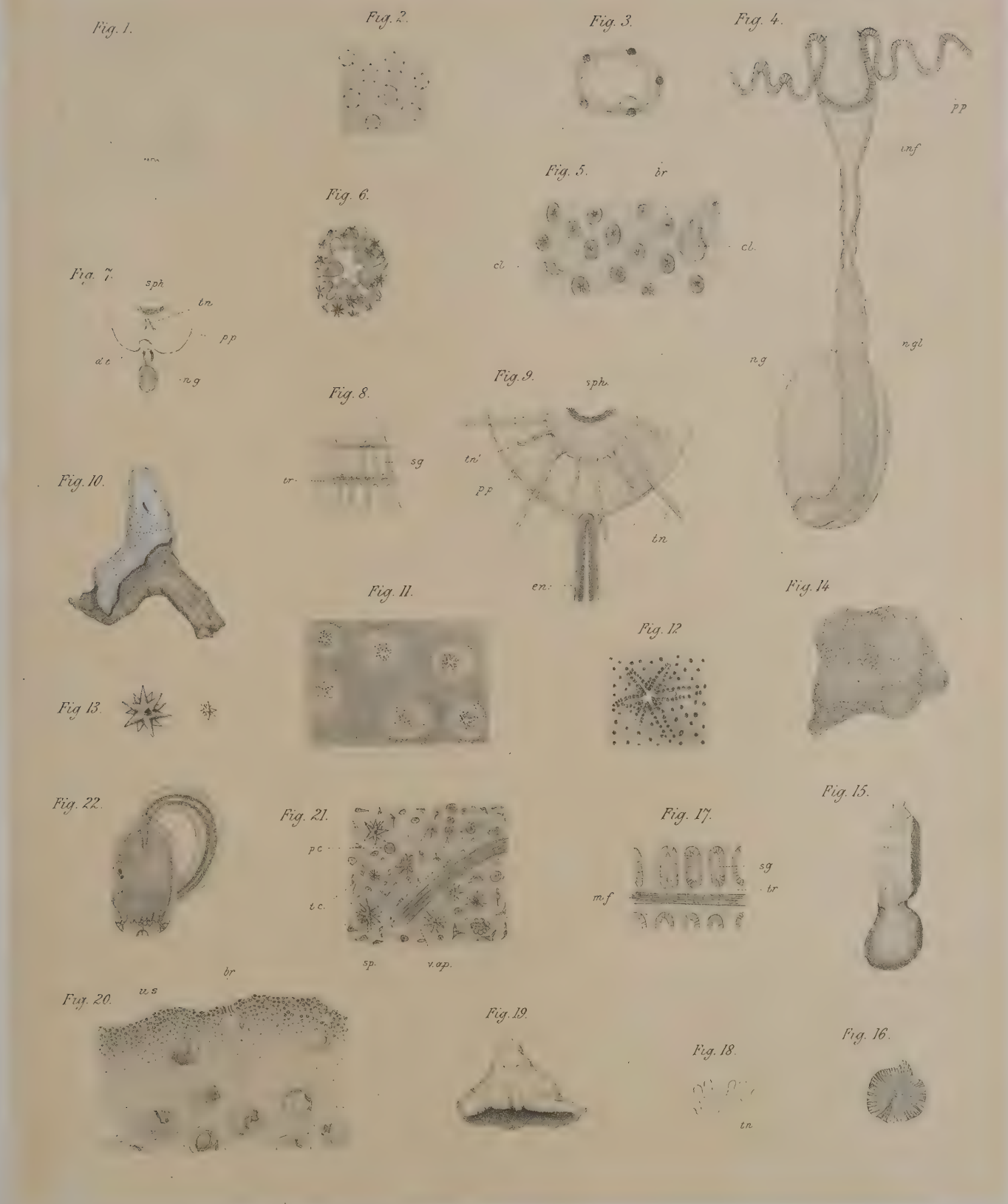
Fig. 18. Some of the tentacles of *Leptoclinum subflavum;* highly magnified (S., $\frac{1}{4}$ inch). *tn.* indicates the dorsal tentacle of the series.

Fig. 19. Colony of *Leptoclinum* (?) *jacksoni;* natural size.

Fig. 20. Part of a transverse section through the colony of *Leptoclinum* (?) *jacksoni*, showing the arrangement of spicules and Ascidiozooids in the test; magnified (S., 1 inch).

Fig. 21. Part of a section through the test of *Leptoclinum* (?) *jacksoni;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 22. Tailed larva of *Leptoclinum* (?) *jacksoni;* magnified (S., 1 inch).



FIGS 1-4, CŒLOCORMUS HUXLEYI, n. sp. FIGS 5-9, LEPTOCLINUM ANNECTENS, n. sp.
FIGS 10-13, LEPTOCLINUM NEGLECTUM, n. sp. FIGS 14-18, LEPTOCLINUM SUBFLAVUM, n. sp.
FIGS 19-22, LEPTOCLINUM (?) JACKSONI, n. sp.

PLATE XXXIX.

PLATE XXXIX.

Figs. 1–7. *Leptoclinum japonicum*, n. sp.
Figs. 8–11. *Leptoclinum tenue*, n. sp.
Figs. 12–15. *Leptoclinum edwardsi*, n. sp.
Figs. 16–20. *Leptoclinum propinquum*, n. sp.

bl. Bladder cell.	*sg.* Stigmata of branchial sac.	*tr.* Transverse vessel of branchial sac.
br. Branchial aperture.	*sg.c.* Ciliated cells bounding stigmata.	*v.d.* Vas deferens.
en. Endostyle.	*t.c.* Test cells.	

Fig. 1. Colony of *Leptoclinum japonicum;* natural size.

Fig. 2. Colony of *Leptoclinum japonicum*, showing base; natural size.

Fig. 3. Section through test of *Leptoclinum japonicum*, stained in aniline blue; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Branchial sac of *Leptoclinum japonicum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Branchial aperture of *Leptoclinum japonicum*, showing arrangement of spicules; magnified (S., 1 inch, enlarged).

Fig. 6. Spicules from test of *Leptoclinum japonicum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 7. Part of testis and vas deferens of *Leptoclinum japonicum;* highly magnified (S., $\frac{1}{6}$ inch).

Fig. 8. Colony of *Leptoclinum tenue;* natural size.

Fig. 9. Part of colony of *Leptoclinum tenue;* slightly enlarged.

Fig. 10. Part of surface of *Leptoclinum tenue*, showing arrangement of Ascidiozooids and spicules; magnified (S., 1 inch).

Fig. 11. Spicules from test of *Leptoclinum tenue;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 12. Colony of *Leptoclinum edwardsi;* natural size.

Fig. 13. Another colony of *Leptoclinum edwardsi;* natural size.

Fig. 14. Branchial sac of *Leptoclinum edwardsi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 15. Spicules from test of *Leptoclinum edwardsi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 16. Colony of *Leptoclinum propinquum;* natural size.

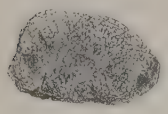
Fig. 17. Part of surface of *Leptoclinum propinquum;* magnified (S., 1 inch).

Fig. 18. Ascidiozooid of *Leptoclinum propinquum*, seen from left side; magnified (S., 1 inch).

Fig. 19. Part of branchial sac of *Leptoclinum propinquum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 20. Spicules from test of *Leptoclinum propinquum;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 1.



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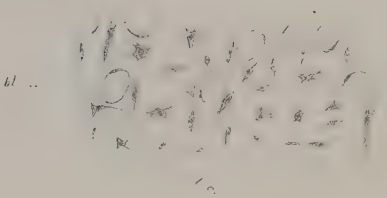

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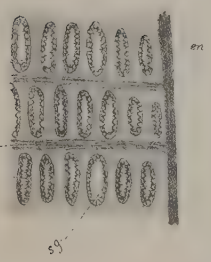

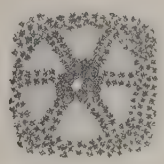

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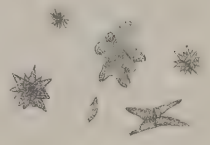


Fig. 7

Fig. 8.

Fig. 9.

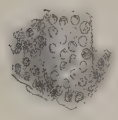


Fig. 11.

Fig. 12.

Fig. 13.

Fig. 17.

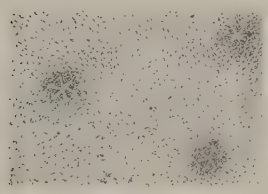
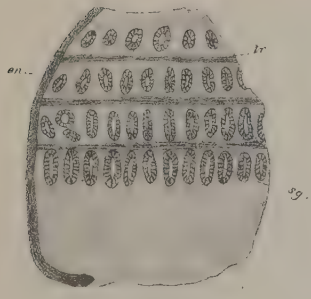


Fig. 19.

Fig. 16



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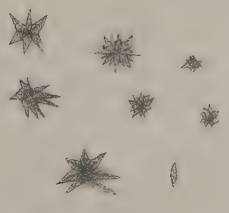

Fig. 15

Fig. 18.

Fig. 20.

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FIGS 1-7. LEPTOCLINUM JAPONICUM, n. sp
FIGS 8-11. LEPTOCLINUM TENUE, n. sp

FIGS 12-15. LEPTOCLINUM EDWARDSI, n. sp
FIGS 16-20. LEPTOCLINUM PROPINQUUM, n. sp.

PLATE XL.

PLATE XL.

Figs. 1, 2. *Leptoclinum tenue*, var. *magnizooidium*, nov.
Figs. 3–5. *Leptoclinum tenue*, n. sp.
Figs. 6–9. *Leptoclinum jeffreysi*, n. sp.
Figs. 10–15. *Leptoclinum albidum*, var. *luteolum*, Verrill.

bl. Bladder cell. | *br.* Branchial aperture. | *l.s.* Lower surface of colony. | *t.m.* Test matrix. | *u.s.* Upper surface of colony.

Fig. 1. Colony of *Leptoclinum tenue*, var. *magnizooidium*; natural size.

Fig. 2. Spicule from test of *Leptoclinum tenue*, var. *magnizooidium*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 3. Colony of *Leptoclinum tenue*, from North Atlantic (H.M.S. "Porcupine"); natural size.

Fig. 4. Spicules of the ordinary size from test of *Leptoclinum tenue*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Very large spicule from test of *Leptoclinum tenue*; highly magnified (S., $\frac{1}{4}$ inch). Figures 2, 4, and 5 are drawn to the same scale. Spicules of sizes intermediate between those shown in figures 4 and 5 are also present.

Fig. 6. Colony of *Leptoclinum jeffreysi*; natural size.

Fig. 7. Vertical section through colony of *Leptoclinum jeffreysi*; magnified (S., 1 inch).

Fig. 8. Part of section through lower part of colony of *Leptoclinum jeffreysi*, showing structure of test; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 9. Spicule from test of *Leptoclinum jeffreysi*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Colony of *Leptoclinum albidum*, var. *luteolum*; natural size.

Fig. 11. Another colony of *Leptoclinum albidum*, var. *luteolum*; natural size.

Fig. 12. Spicules from test of *Leptoclinum albidum*, var. *luteolum*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 13. Larva of *Leptoclinum albidum*, var. *luteolum*, showing well-developed branchial sac co-existing with larval tail, adhering organs, &c.; magnified (S., 1 inch).

Fig. 14. Part of test of tailed larva of *Leptoclinum albidum*, var. *luteolum*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 15. Adhering organ of tailed larva of *Leptoclinum albidum*, var. *luteolum*; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 2.

Fig. 4.

Fig. 1.

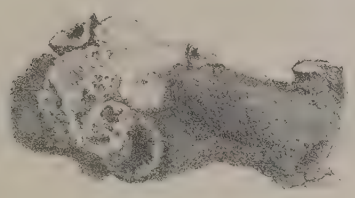
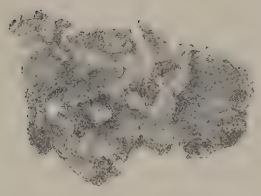


Fig. 3.

Fig 5.



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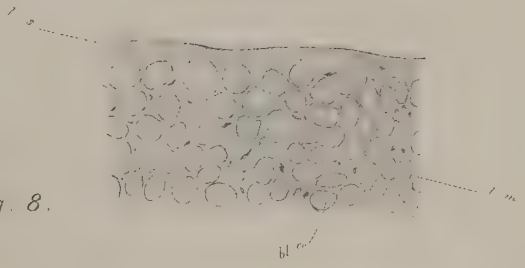

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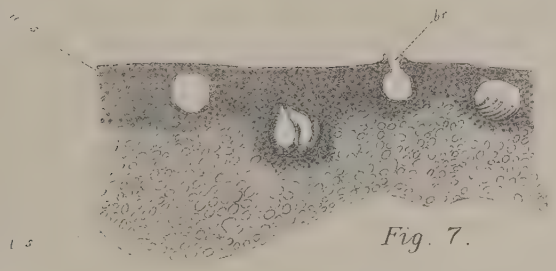

Fig. 7.

Fig. 9.

Fig. 15.

Fig. 13.

Fig. 14.

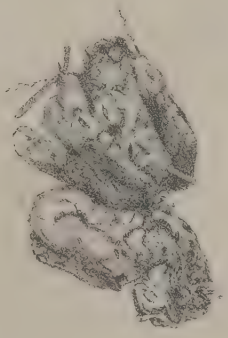

Fig. 11.

Fig. 10.

Fig. 12.

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FIGS 1-2 LEPTOCLINUM TENUE, var MAGNIZOOIDIUM, nov. FIGS 6-9 LEPTOCLINUM JEFFREYSI, n. sp.
FIGS 3-5 LEPTOCLINUM TENUE, n. sp. FIGS 10-15 LEPTOCLINUM ALBIDUM var. LUTEOLUM, Verrill.

PLATE XLI.

PLATE XLI.

Figs. 1–4. *Leptoclinum carpenteri*, n. sp.
Figs. 1, 5–7. *Leptoclinum thomsoni*, n. sp.

br. Branchial aperture.
en. Endostyle.
l.v. Fine longitudinal vessels of branchial sac.
m.b. Muscle band in mantle.
œ. Œsophagus.
r. Rectum.
sg. Stigmata of branchial sac.
sp. Calcareous spicule in test.
st. Stomach.
t.c. Test cells.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v. Vessel in the test.

Fig. 1. Colonies of—A. *Leptoclinum thomsoni*, and B. *Leptoclinum carpenteri;* natural size.

Fig. 2. Part of a vertical section through the colony of *Leptoclinum carpenteri*, showing arrangement of spicules and structure of Ascidiozooids; magnified (S., 1 inch).

Fig. 3. Section through test of *Leptoclinum carpenteri;* highly magnified (S., $\frac{1}{4}$ inch).

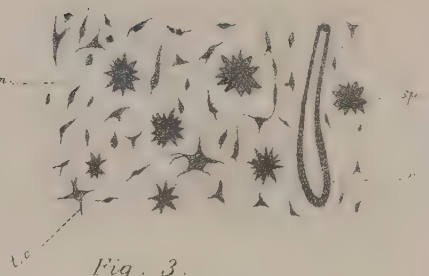
Fig. 4. Part of branchial sac of *Leptoclinum carpenteri;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Part of a vertical section through the colony of *Leptoclinum thomsoni*, showing arrangement of spicules and structure of Ascidiozooids; magnified (S., 1 inch).

Fig. 6. Spicules from test of *Leptoclinum thomsoni;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 7. Part of a vertical section through upper part of colony of *Leptoclinum thomsoni*, showing the thoracic region of an Ascidiozooid and the neighbouring test; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 2.



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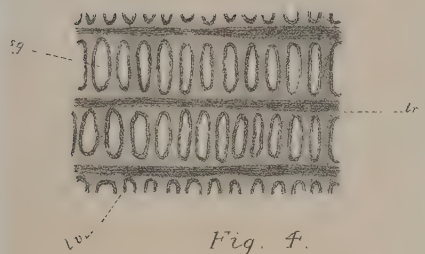

Fig. 4.

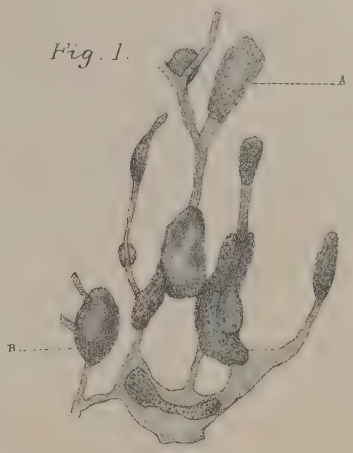

Fig. 1.

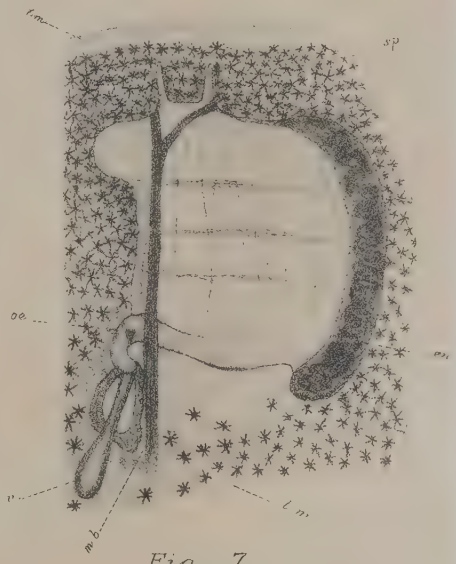

Fig. 7.

Fig. 5.

Fig 6.

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FIGS 1-4. LEPTOCLINUM CARPENTERI, n. sp
FIGS 1, 5-7 LEPTOCLINUM THOMSONI, n. sp.

PLATE XLII.

PLATE XLII.

Figs. 1–4. *Diplosoma macdonaldi*, n. sp.
Figs. 5–16. *Diplosomoides molle*, n. sp.

bl. Bladder cell.
br. Branchial aperture.
br.s., *br.s'.* Branchial sac.
d.l. Dorsal lamina.
d.t. Dorsal tubercle.
en. Endostyle.
i., *i'.* Intestine.
l. Languet.
l.v. Fine longitudinal vessels of branchial sac.
m.f. Muscle fibres.
œ. Œsophagus.
p.p. Peripharyngeal band.
sg. Stigmata of branchial sac.
st, *st'.* Stomach.
t.c. Test cells.
tn, *tn'.* Tentacles.
tr. Transverse vessel of branchial sac.
v.ap. Vascular appendage.

Fig. 1. Colony of *Diplosoma macdonaldi*, attached to a Hydroid Zoophyte along with a Polyzoon and a Sponge; natural size.

Fig. 2. Part of colony of *Diplosoma macdonaldi*, showing Ascidiozooids; magnified (S., 1 inch).

Fig. 3. Part of test of *Diplosoma macdonaldi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Part of branchial sac of *Diplosoma macdonaldi;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 5. Colony of *Diplosomoides molle;* natural size.

Fig. 6. Part of colony of *Diplosomoides molle*, showing Ascidiozooids; magnified (S., 1 inch, reduced).

Fig. 7. Ascidiozooid of *Diplosomoides molle*, seen from right side, showing gemmation (*br.s'*, *st'*, *i'*); magnified (S., 1 inch).

Fig. 8. Another Ascidiozooid of *Diplosomides molle*, seen from right side, showing gemmation; magnified (S., 1 inch).

Fig. 9. Ascidiozooid of *Diplosomoides molle*, seen from left side; magnified (S., 1 inch).

Fig. 10. Vascular appendage of *Diplosomoides molle;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 11. Optical section of bulb on vascular appendage; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 12. Spicules from test of *Diplosomoides molle;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 13. Anterior end of Ascidiozooid seen from branchial sac, showing tentacles, &c.; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 14. Part of branchial sac of *Diplosomoides molle;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 15. Small part of dorsal edge of branchial sac of a young Ascidiozooid of *Diplosomoides molle*, showing languets; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 16. Dorsal languets of an adult Ascidiozooid of *Diplosomoides molle;* highly magnified (S., $\frac{1}{4}$ inch).

Fig 1.

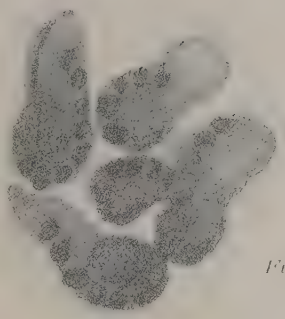
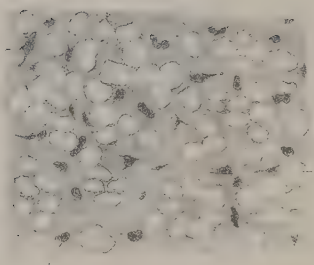


Fig 2

Fig 3



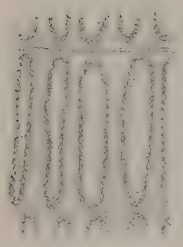
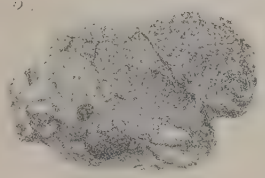


Fig 4

Fig 5.



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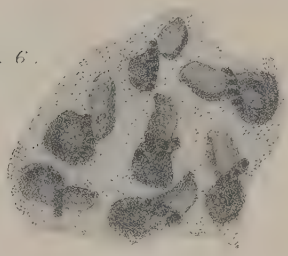

Fig 10

Fig 11.

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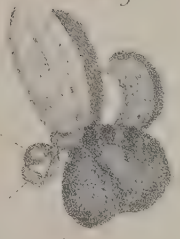

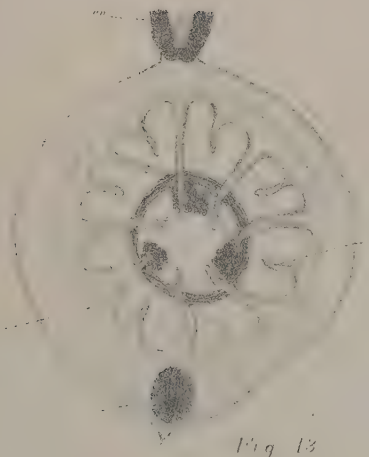

Fig 13

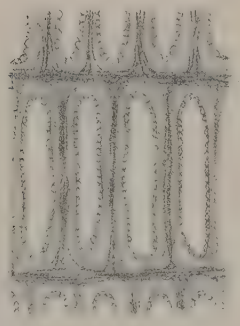

Fig 14

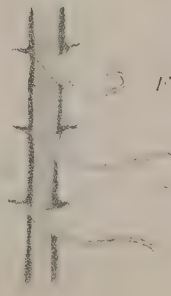

Fig 16

Fig 15

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FIGS 1-4, DIPLOSOMA MACDONALDI, n.sp.
FIGS 5-16, DIPLOSOMOIDES MOLLE, n.sp.

PLATE XLIII.

PLATE XLIII.

Figs. 1–10. *Goodsiria placenta*, n. sp.

a. Anus.	*i.* Intestine.	*r.* Rectum.
at. Atrial aperture.	*i.l.* Internal longitudinal bar of branchial sac.	*sg.* Stigmata of branchial sac.
at.tn. Atrial tentacles.	*m.* Mantle.	*st.* Stomach.
br.f. Fold in branchial sac.	*n.g.* Nerve ganglion.	*tn, tn'.* Tentacles.
d.l. Dorsal lamina.	*œ.* Œsophagus.	*tr.* Transverse vessel of branchial sac.
h.t. Glandular tubules on wall of intestine.	*p.p.* Peripharyngeal band.	*ves.* Vesicle into which the glandular tubules open.

Fig. 1. Colony of *Goodsiria placenta*; natural size.

Fig. 2. Transverse section of colony of *Goodsiria placenta*; natural size.

Fig. 3. Part of the test of *Goodsiria placenta*, showing vessels; magnified (S., 1 inch).

Fig. 4. Part of branchial sac of *Goodsiria placenta*, showing folds and dorsal lamina; magnified (S., 1 inch).

Fig. 5. Alimentary canal of *Goodsiria placenta*; slightly enlarged.

Fig. 6. Alimentary canal of another Ascidiozooid of *Goodsiria placenta*; magnified (S., 1 inch, reduced).

Fig. 7. Glandular tubules from wall of intestine; highly magnified (S., $\frac{1}{4}$ inch).

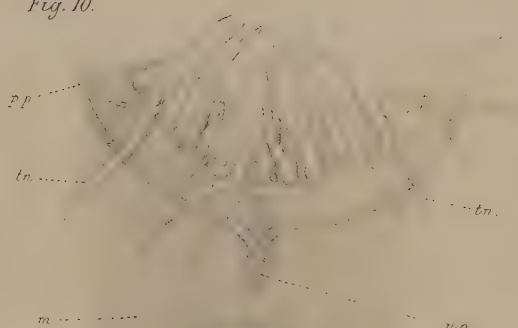
Fig. 8. Part of intestine and stomach showing glandular tubules opening into a vesicle which communicates with the stomach; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 9. Tailed larva of *Goodsiria placenta*; magnified (S., 1 inch, reduced).

Fig. 10. Anterior part of Ascidiozooid of *Goodsiria placenta*, showing branchial and atrial tentacles, &c.; magnified (S., 1 inch).

Fig. 1.

Fig. 10.



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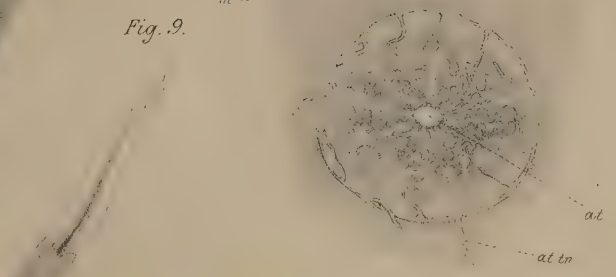

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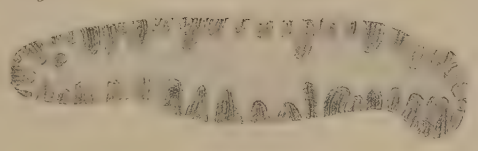


Fig. 8

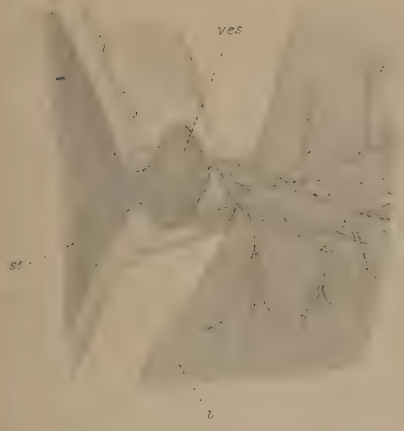


Fig. 7.

Fig. 6

Fig. 5.

Fig. 3

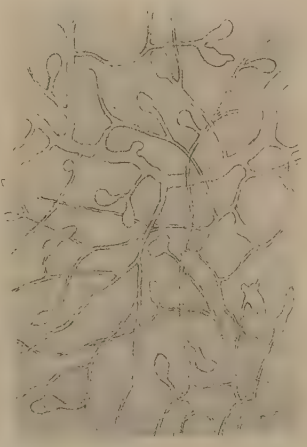
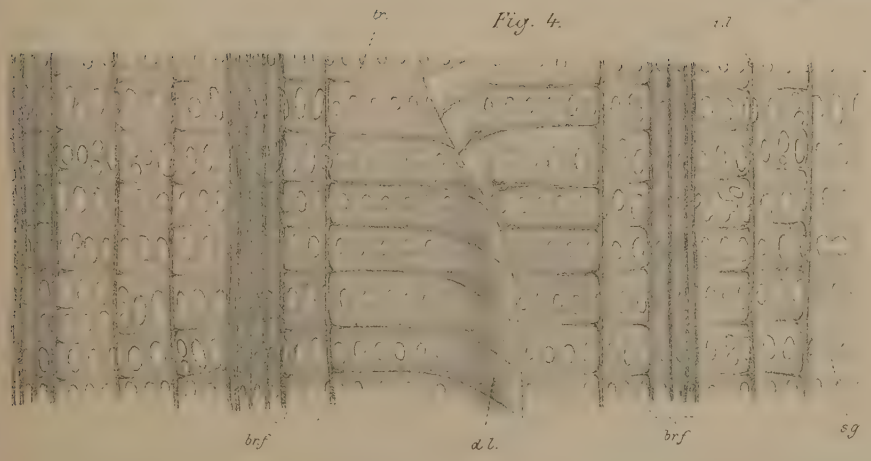


Fig. 4.



W.A. Herdman del.

Hanh. Lith. Est.

GOODSIRIA PLACENTA, n. sp.

PLATE XLIV.

PLATE XLIV.

Figs. 1–3. *Goodsiria pedunculata*, n. sp.
Figs. 4, 8–10. *Goodsiria placenta*, n. sp.
Figs. 5–7. *Goodsiria placenta*, var. *fusca*, nov.

b.c. Pigmented cells in mantle.
br.f., *br.f'.* Folds in branchial sac.
b.v. Blood-vessels in wall of stomach.
ep. Ciliated epithelium in interior of stomach.
fd. Fold in wall of stomach.
i.l. Internal longitudinal bar of branchial sac.
m. Mantle.
o. Ovum.
o.d. Oviduct.
sg. Stigmata of branchial sac.
t. Test.
tr. Transverse vessels of branchial sac.
t.v. Spermatic vesicles.
ty. Typhlosole or large fold in stomach wall.
v.d. Vas deferens.

Fig. 1. Colony of *Goodsiria pedunculata;* natural size.

Fig. 2. Part of branchial sac of *Goodsiria pedunculata*, seen from the interior; magnified (S., 1 inch).

Fig. 3. Transverse section of the stomach of *Goodsiria pedunculata*, showing the numerous large folds; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 4. Longitudinal vertical section through one of the polycarps of *Goodsiria placenta;* magnified (S., 1 inch).

Fig. 5. Colony of *Goodsiria placenta*, var *fusca;* natural size.

Fig. 6. Part of the branchial sac of *Goodsiria placenta*, var. *fusca*, showing one complete and one rudimentary fold; magnified (S., 1 inch).

Fig. 7. Part of the mantle of *Goodsiria placenta*, var. *fusca*, showing arrangement of muscle bands and pigment cells; magnified (S., 1 inch).

Fig. 8. Transverse section of polycarp of *Goodsiria placenta;* magnified (S., 1 inch).

Fig. 9. Oblique section through a polycarp of *Goodsiria placenta*, showing its relations to the mantle and test; magnified (S., 1 inch).

Fig. 10. Two spermatic vesicles from the polycarp of *Goodsiria placenta;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 3.

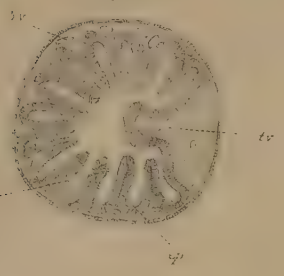


Fig. 2.

Fig. 1.

Fig. 4.

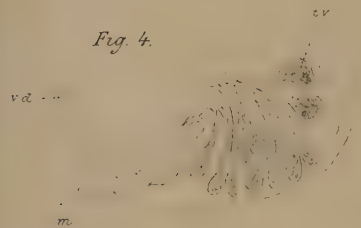
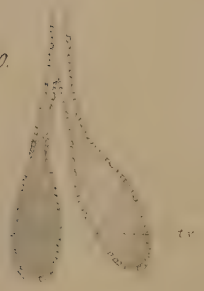


Fig. 5.

Fig. 10.



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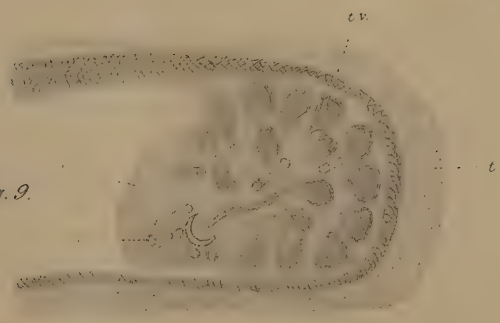

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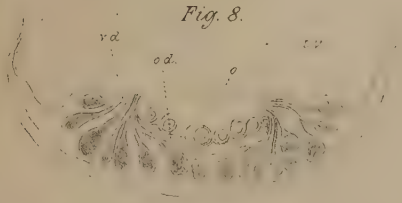

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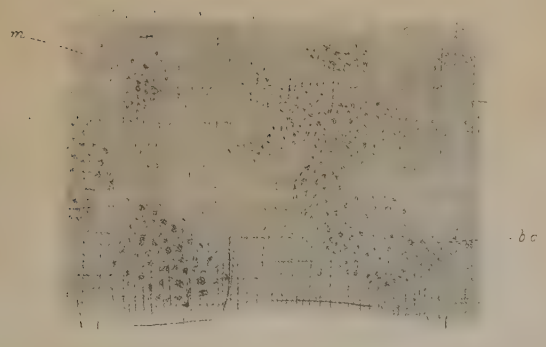

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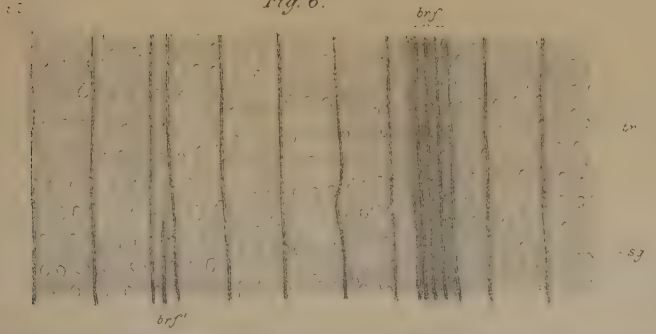

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F. Huth, Lith^r Edin^r

FIG^s 1-3, GOODSIRIA PEDUNCULATA, n. sp. FIG^s 4, 8-10, GOODSIRIA PLACENTA, n sp.
FIG^s 5-7, GOODSIRIA PLACENTA, var. FUSCA, nov.

PLATE XLV.

PLATE XLV.

Goodsiria coccinea, Cunningham.

a. Anus.
at. Atrial aperture.
br. Branchial aperture.
b.v. Blood-vessel.
ec. Ectoderm.
en. Endostyle.
end. Endoderm.
i. Intestine.
i.l. Internal longitudinal bar of branchial sac.
l.v. Fine longitudinal vessels of branchial sac.
m. Mantle.
mes. Mesoderm.
o. Ovum.
o.d. Oviduct.
œ. Œsophagus.
p.br.c. Peribranchial cavity.
r. Rectum.
sg. Stigmata of branchial sac.
st. Stomach.
t.k. Terminal bulb on vessel in test.
t.m. Test matrix.
tr. Transverse vessel of branchial sac.
tr'. Smaller transverse vessel of branchial sac.
t.v. Spermatic vesicles.
v. Vessel in test.
v.d. Vas deferens.

Fig. 1. Part of large colony of *Goodsiria coccinea;* natural size.

Fig. 2. Several small colonies of *Goodsiria coccinea;* natural size.

Fig. 3. Anterior end of Ascidiozooid, showing apertures; enlarged.

Fig. 4. Part of test of *Goodsiria coccinea*, showing vessels; magnified (S., 1 inch).

Fig. 5. Part of branchial sac of *Goodsiria coccinea*, seen from interior; magnified (S., 1 inch).

Fig. 6. Part of branchial sac of young Ascidiozooid, seen from interior; magnified (S., 1 inch).

Fig. 7. Part of branchial sac of adult Ascidiozooid, seen from interior; magnified (S., 1 inch).

Fig. 8. Small part of branchial sac, seen from the interior; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 9. Vascular appendage attached to posterior end of Ascidiozooid; magnified (S., 1 inch).

Fig. 10. Transverse section of vascular appendage in test; magnified (S., 1 inch).

Fig. 11. Small part of transverse section of vascular appendage; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 12. Origin of vascular appendage from posterior end of Ascidiozooid; magnified (S., 1 inch).

Fig. 13. Section through mantle and polycarps of *Goodsiria coccinea;* highly magnified (S., $\frac{1}{4}$ inch).

Fig. 14. Polycarp of *Goodsiria coccinea*, dissected out; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 15. Endocarp of *Goodsiria coccinea*, detached from mantle; magnified (S., 1 inch).

Fig. 16. Transverse section through endostyle and neighbouring structures; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 17. Alimentary canal of *Goodsiria coccinea*; enlarged.

Fig. 18. Section across stomach of *Goodsiria coccinea*, showing folds in the interior; magnified (S., 1 inch).

Fig. 19. Stomach of another Ascidiozooid of *Goodsiria coccinea*, showing the cæcum; enlarged.

Fig. 1

Fig. 2

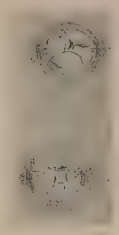


Fig. 3.

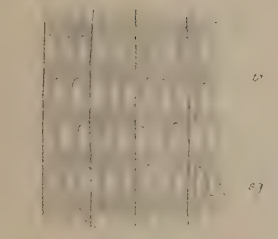


Fig. 5

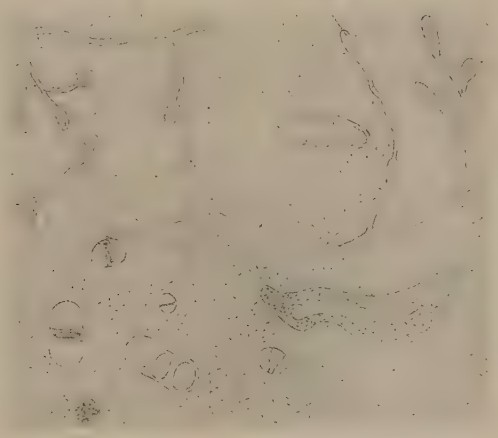
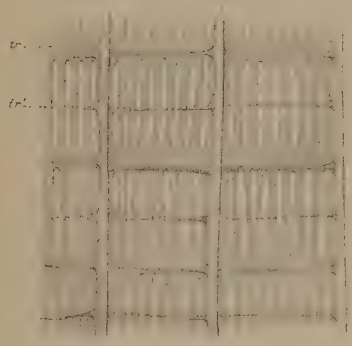


Fig. 4



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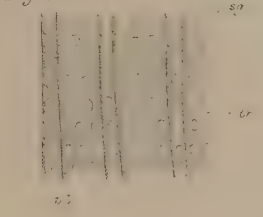
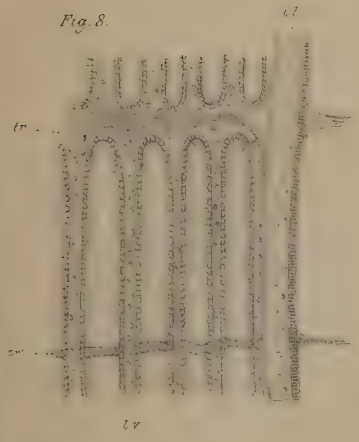


Fig. 6.

Fig. 15



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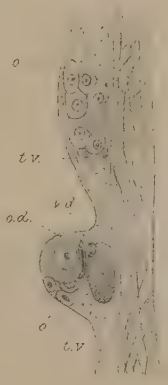


Fig. 13.

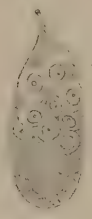
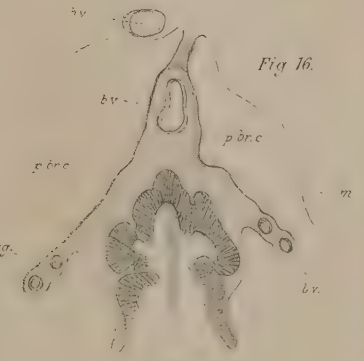


Fig. 14.



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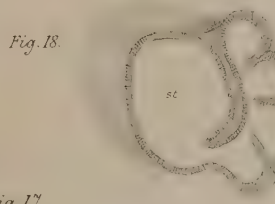

Fig. 18.

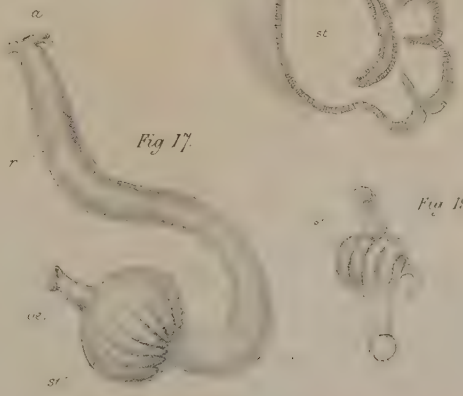

Fig. 17.

Fig. 19

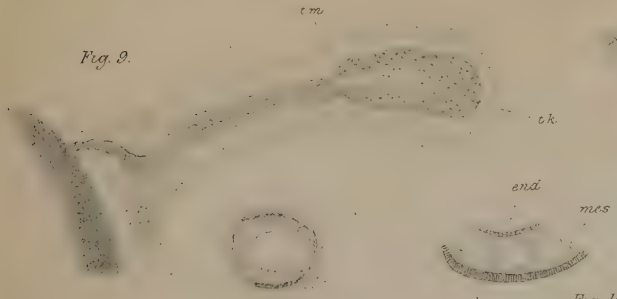

Fig. 9.

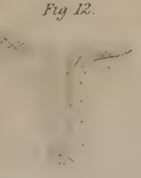

Fig. 12.

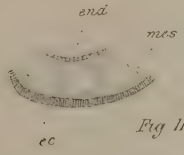

Fig. 11.

Fig. 10.

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F. Huth, Lith.r Edin.r

GOODSIRIA COCCINEA, Cunningham.

PLATE XLVI.

PLATE XLVI.

Figs. 1–8. *Chorizocormus reticulatus*, n. sp.
Figs. 9–14. *Synstyela incrustans*, n. sp.

d.t. Dorsal tubercle.	*ov.* Ova.	*tn, tn'.* Tentacles.
en.c. Endocarp.	*p.p.* Peripharyngeal band.	*tr, tr'.* Transverse vessel of branchial sac.
g. Polycarp.	*t.k.* Terminal bulb on vessel in test.	*t.v.* Spermatic vesicles.
i.l. Internal longitudinal bar of branchial sac.	*t.m.* Test matrix.	*v.* Vessel in test.

Fig. 1. Large colony of *Chorizocormus reticulatus;* natural size.

Fig. 2. Small colony of *Chorizocormus reticulatus;* natural size.

Fig. 3. Small colony of *Chorizocormus reticulatus;* natural size.

Fig. 4. Another small colony of *Chorizocormus reticulatus;* natural size.

Fig. 5. Part of stolon of *Chorizocormus reticulatus*, showing vessels; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 6. Part of branchial sac of *Chorizocormus reticulatus*, seen from the interior; magnified (S., 1 inch).

Fig. 7. Dorsal part of anterior end of Ascidiozooid of *Chorizocormus reticulatus*, showing tentacles, dorsal tubercle, &c; magnified (S., 1 inch).

Fig. 8. Part of mantle of *Chorizocormus reticulatus*, seen from the inner surface, showing attached female polycarps (*g.*); magnified (S., 1 inch).

Fig. 9. Colony of *Synstyela incrustans;* natural size.

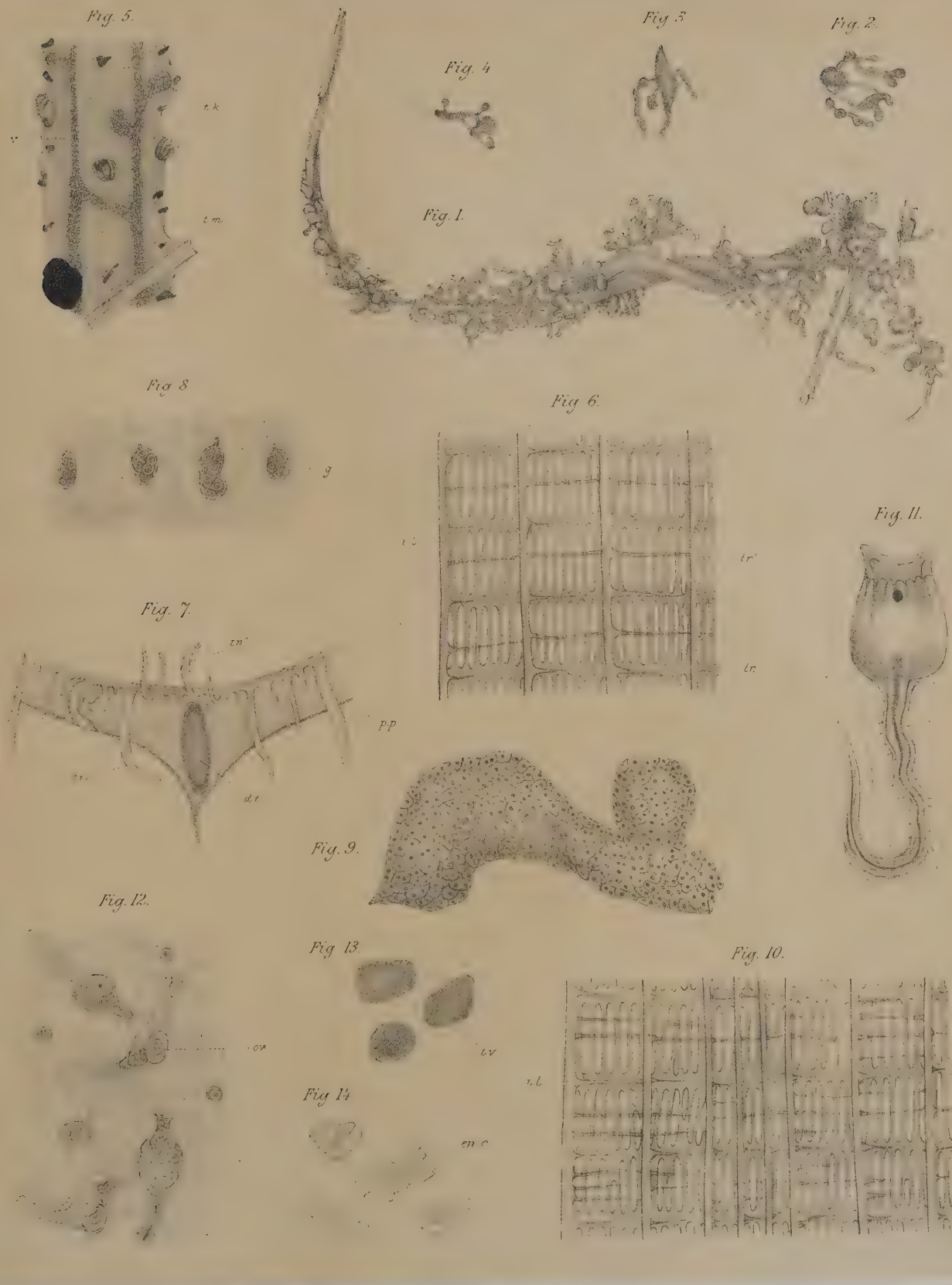
Fig. 10. Part of branchial sac of *Synstyela incrustans*, seen from the interior; magnified (S., 1 inch).

Fig. 11. Larva of *Synstyela incrustans*, showing structure of tail; magnified (S., 1 inch).

Fig. 12. Part of mantle of *Synstyela incrustans*, seen from the inner surface, showing female polycarps (*ov.*) in various stages of development; magnified (S., 1 inch).

Fig. 13. Three male polycarps (*t.v.*) detached from mantle; magnified (S., 1 inch).

Fig. 14. Four endocarps (*en.c.*) detached from mantle; magnified (S., 1 inch).



W. A. Faulkner, sc.

Smith, Lith. Edin.

FIGS 1-8, CHORIZOCORMUS RETICULATUS, n. sp.

FIGS 9-14, SYNSTYELA INCRUSTANS, n sp.

PLATE XLVII.

PLATE XLVII.

Figs. 1, 2. *Molgula carpenteri*, n. sp.
Figs. 3–5. *Polycarpa aspera*, n. sp.
Fig. 6. *Bathyoncus discoideus*, n. sp.
Figs. 7–10. *Bathyoncus minutus*, n. sp.
Fig. 11. *Ascidia scabra* (?), O. F. Müller.

at. Atrial aperture.	*m.b.* Muscle bands.	*tn, tn'.* Large and small tentacles.
br. Branchial aperture.	*œ.* Œsophagus.	*tr, tr', tr''.* Transverse vessels of branchial sac.
g. Reproductive organs.	*sg.* Stigmata of branchial sac.	
i. Intestine.	*st.* Stomach.	

Fig. 1. Specimen of *Molgula carpenteri*, seen from side; natural size.

Fig. 2. Part of the branchial sac of *Molgula carpenteri*, seen from the inside; magnified (S., 1 inch).

Fig. 3. Specimen of *Polycarpa aspera*; natural size.

Fig. 4. Part of the branchial sac of *Polycarpa aspera*, seen from inside; magnified (S., 1 inch).

Fig. 5. Tentacles of *Polycarpa aspera*; magnified (S., 1 inch).

Fig. 6. Diagram showing the course of the alimentary canal in *Bathyoncus discoideus*; natural size.

Fig. 7. Specimen of *Bathyoncus minutus*; natural size.

Fig. 8. Alimentary canal of *Bathyoncus minutus*; magnified (S., 1 inch, reduced).

Fig. 9. Branchial aperture, &c., of *Bathyoncus minutus*, seen from the inside, showing tentacles, muscle bands, &c.; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 10. Atrial aperture, &c., of *Bathyoncus minutus*, seen from the inside, showing muscle bands; highly magnified (S., $\frac{1}{4}$ inch).

Fig. 11. Specimen of *Ascidia scabra* (?), O. F. Müller, with test removed, seen from right hand side, showing enlarged atrial siphon; natural size.

Fig. 1.

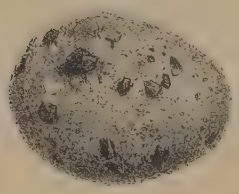


Fig. 5.

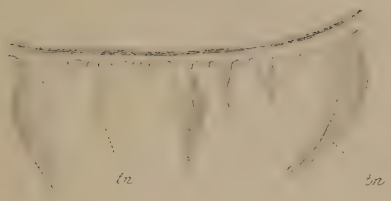


Fig. 3.

Fig. 2.

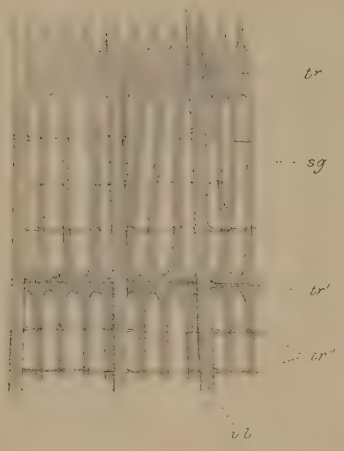


Fig. 6.

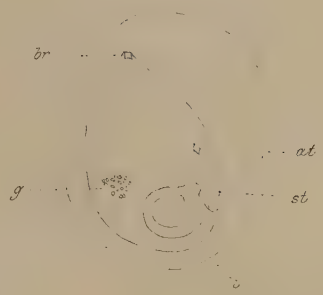


Fig. 4

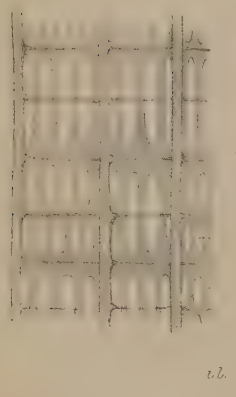
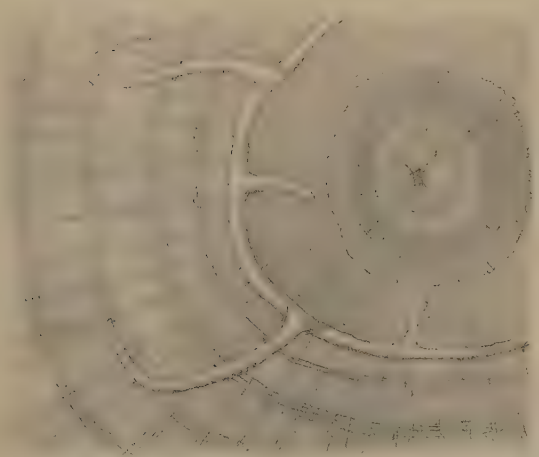


Fig. 7

Fig. 8.

Fig. 11.

Fig. 9.



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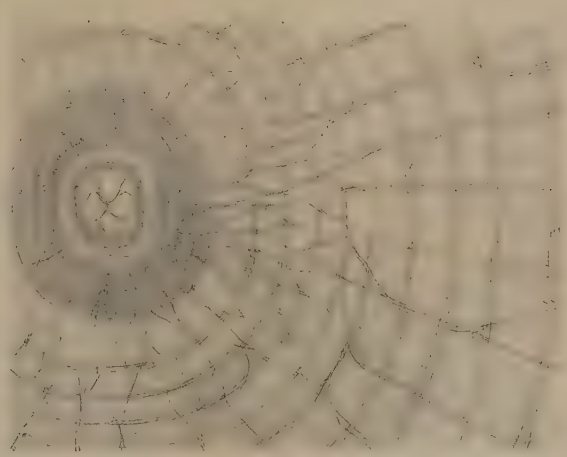


FIGs 1 & 2, MOLGULA CARPENTERI, n. sp FIGs 3-5, POLYCARPA ASPERA, n sp
FIG. 6, BATHYONCUS DISCOIDEUS, n sp. FIGs 7-10, BATHYONCUS MINUTUS n sp
FIG. 11, ASCIDIA SCABRA, O F Müller (?)

PLATE XLVIII.

PLATE XLVIII.

Figs. 1–4. *Culeolus willemœsi*, n. sp.
Figs. 5–11. *Bathyoncus discoideus*, n. sp.

br.f. Longitudinal fold in branchial sac. | *i.l.* Internal longitudinal bar of branchial sac. | *sp.* Spicule. *tr.* Transverse vessel of branchial sac.

Fig. 1. *Culeolus willemœsi;* natural size.

Fig. 2. Part of the branchial sac of *Culeolus willemœsi;* magnified (S., 1 inch).

Fig. 3. Branchial aperture of *Culeolus willemœsi;* enlarged.

Fig. 4. One of the tentacles of *Culeolus willemœsi;* magnified (S., 1 inch).

Fig. 5. *Bathyoncus discoideus;* natural size.

Fig. 6. Part of the mantle of *Bathyoncus discoideus;* magnified (S., 1 inch).

Fig. 7. One of the tentacles of *Bathyoncus discoideus;* magnified (S., 1 inch).

Fig. 8. Part of the branchial sac of *Bathyoncus discoideus;* magnified (S., 1 inch).

Fig. 9. One of the large folds from the branchial sac of *Bathyoncus discoideus*; magnified (S., 1 inch).

Fig. 10. Part of one of the internal longitudinal bars from the branchial sac of *Bathyoncus discoideus*, showing the spicules, &c.; highly magnified (S., $\frac{1}{6}$ inch).

Fig. 11. One of the groups of reproductive organs of *Bathyoncus discoideus*, dissected off from the mantle; enlarged.

Fig. 1.

Fig. 2.

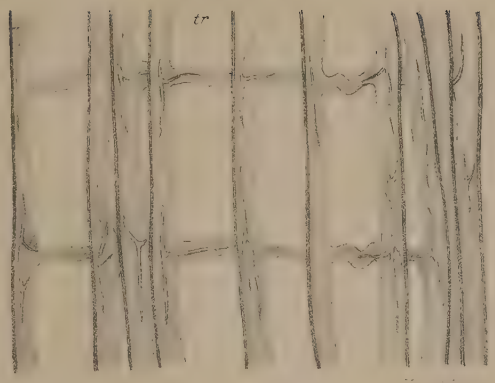


Fig. 3.

Fig. 4.

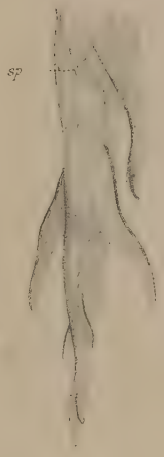


Fig. 6.

Fig. 5.

Fig. 7.

Fig. 11.

Fig. 9.

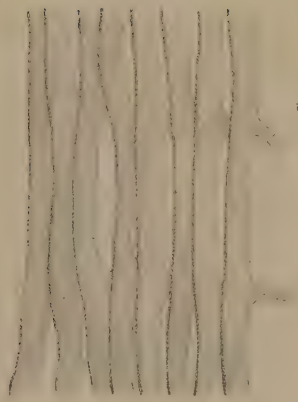


Fig. 8.

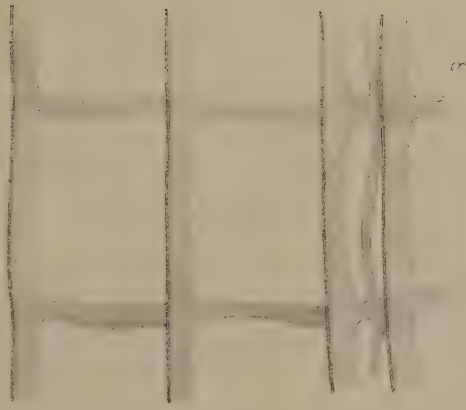


Fig. 10.

W. A. Herdman del.

F. Huth, Lith. Edin.

FIGS 1-4, CULEOLUS WILLEMOESI, n. sp. FIGS 5-11, BATHYONCUS DISCOIDEUS, n. sp.

PLATE XLIX.

PLATE XLIX.

Figs. 1–3. *Polycarpa bassi*, n. sp.
Figs. 4–6. *Polycarpa longisiphonica* (?), Herdman.
Figs. 7, 8. *Styela pusilla*, n. sp.
Figs. 9, 10. *Styela radicosa* (?), Herdman.
Figs. 11–13. *Ciona aspera*, n. sp.

br.f. Longitudinal fold in branchial sac. *i.l.* Internal longitudinal bars of branchial sac. | *p.* Papillæ on the internal longitudinal bars. | *sg.* Stigmata. *tr*, *tr'*. Large and small transverse vessels.

Fig. 1. *Polycarpa bassi;* natural size.

Fig. 2. Part of branchial sac of *Polycarpa bassi*, seen from the inside; magnified (S., 1 inch).

Fig. 3. Dissection of *Polycarpa bassi*, showing branchial sac and course of alimentary canal; natural size.

Fig. 4. *Polycarpa longisiphonica* (?); natural size.

Fig. 5. Part of the branchial sac of *Polycarpa longisiphonica* (?), seen from the inside; magnified (S., 1 inch).

Fig. 6. Part of the ectoderm of *Polycarpa longisiphonica* (?); highly magnified (S., $\frac{1}{4}$ inch).

Fig. 7. *Styela pusilla;* natural size.

Fig. 8. Part of the branchial sac of *Styela pusilla*, seen from the inside; magnified (S., 1 inch).

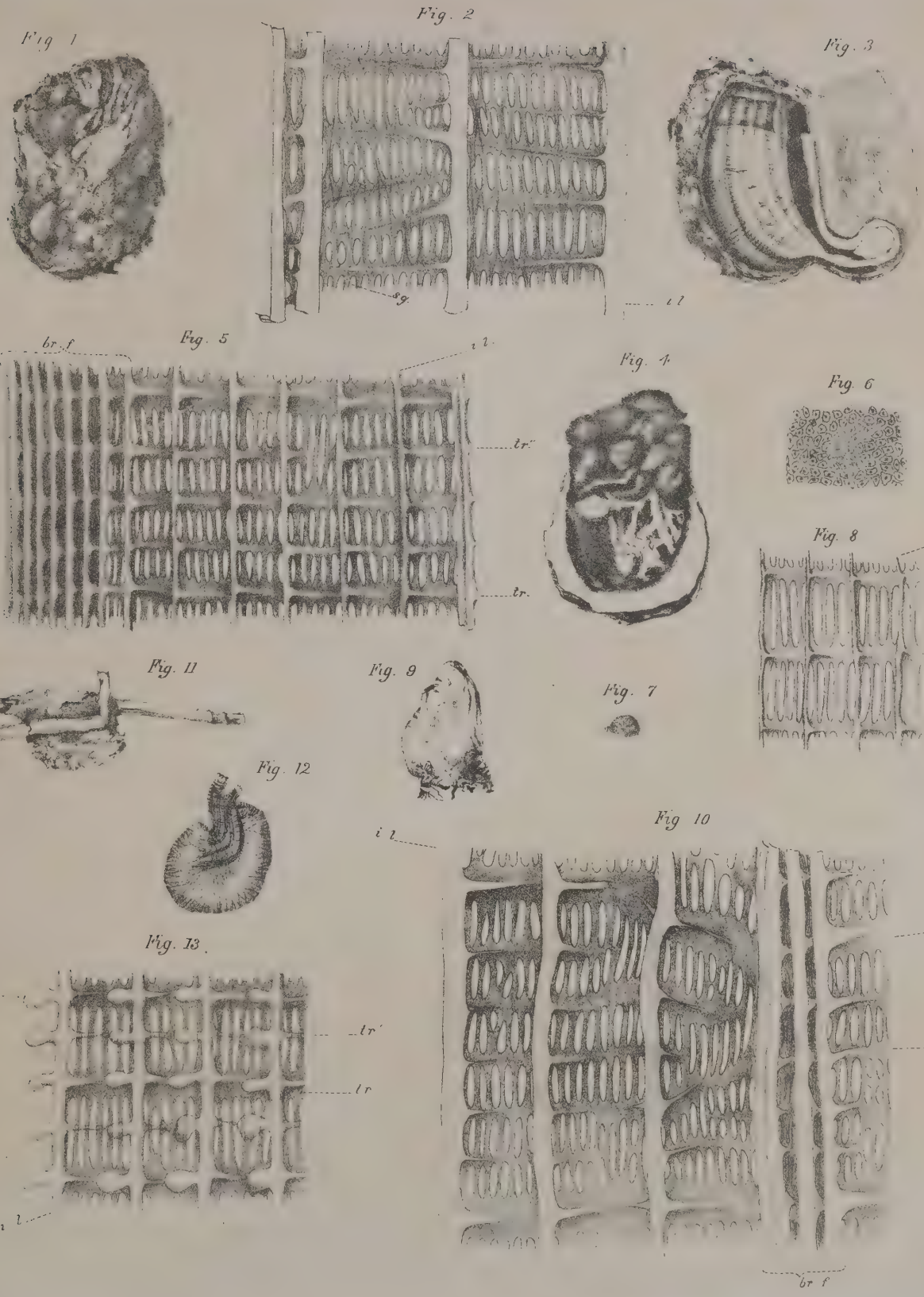
Fig. 9. *Styela radicosa* (?), from right side; natural size.

Fig. 10. Part of the branchial sac of *Styela radicosa* (?), seen from inside; magnified (S., 1 inch).

Fig. 11. *Ciona aspera;* natural size.

Fig. 12. *Ciona aspera*, with test removed; slightly enlarged.

Fig. 13. Part of the branchial sac of *Ciona aspera*, seen from the inside; magnified (S., 1 inch).



FIGS 1-3 POLYCARPA BASSI, n.sp. FIGS 4-6 POLYCARPA LONGISIPHONICA, Herdman (?)

FIGS 7-8 STYELA PUSILLA, n.sp. FIGS 9-10 STYELA RADICOSA, Herdman (?)

FIGS 11-13 CIONA ASPERA, n.sp.

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